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U.S. Dept. of Army

WAR DEPARTMENT

TECHNICAL MANUAL

ORDNANCE MAINTENANCE

**155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1;
HEAVY CARRIAGE LIMBER M2**

15 JULY 1943

FOR ORDNANCE PERSONNEL ONLY

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ORDNANCE MAINTENANCE: 155-MM GUNS M1 AND M1A1 AND CARRIAGE M1; 8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2.

Prepared under the direction of the
Chief of Ordnance

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Section I

INTRODUCTION

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1. SCOPE.

a. This manual is published for the information and guidance of ordnance maintenance personnel. It contains detailed instructions for inspection, disassembly, assembly, maintenance, and repair of 155-mm Guns M1 and M1A1 and Carriage M1; 8-inch Howitzer M1 and Carriage M1; and Heavy Carriage Limber M2. It is supplementary to manuals now in the field, and to Technical Manuals prepared for the using arms. Additional descriptive material and illustrations are included to aid in providing a complete working knowledge of the materiel.

2. CHARACTERISTICS.

a. **8-inch Howitzer M1 and 8-inch Howitzer Carriage M1.** This weapon is mobile and has split trails. It is composed of the following major units.

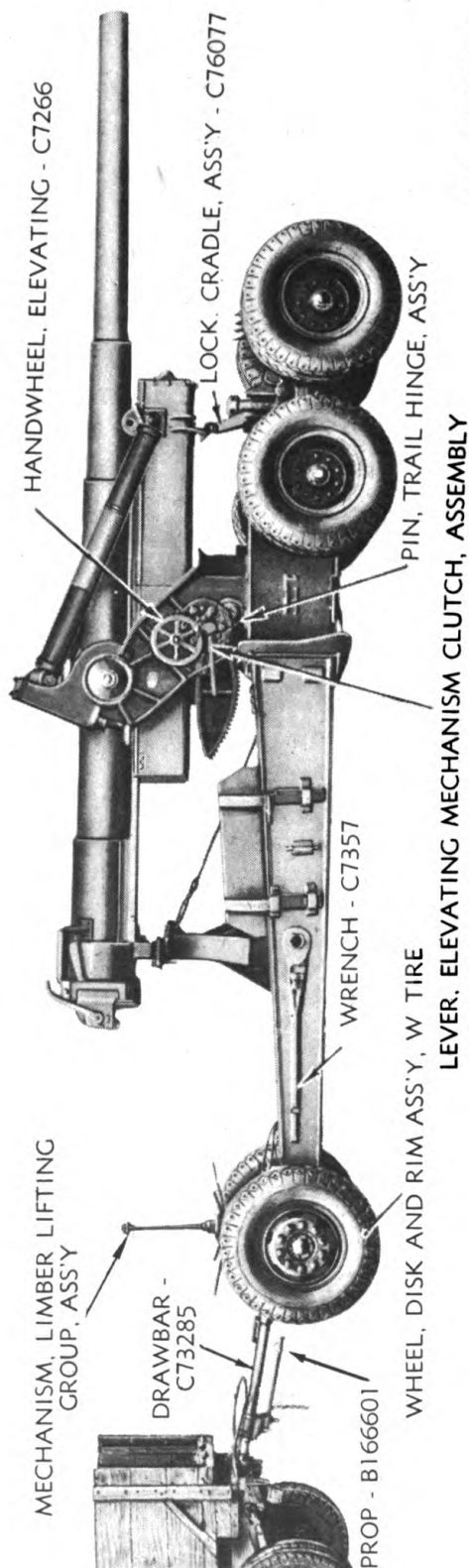
- (1) Howitzer, 8-in., M1
- (2) Carriage, howitzer, 8-in., M1
- (3) Mechanism, recoil, M4
- (4) Limber, heavy carriage, M2

b. **155-mm Gun M1 or M1A1 and Gun Carriage M1.** This weapon is composed of the following major units:

- (1) Gun, 155-mm, M1A1 or M1.
- (2) Carriage, gun, 155-mm, M1.
- (3) Mechanism, recoil, M3.
- (4) Limber, heavy carriage, M2.

c. **Bogie and Limber M2.** For traveling, most of the weight of the weapon is supported on a 2-axle bogie (which is considered part of the carriage). The remainder of the weight is usually carried by the Heavy Carriage Limber M2 which supports the ends of the trails. The drawbar is attached to the limber. In some cases, no limber is used. Instead, the carriage is drawn by a special prime mover having a goose-neck attachment. Road control of the materiel in traveling is effected from the prime mover by a power-air-brake system with equalized brakes on the four bogie wheels. The two front wheels of the bogie are also equipped with levers for operating the brakes by hand. These are used for parking when the carriage is disconnected from the prime mover, and in case of failure of the power brake system.

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Figure 1—155-mm Gun Material—Traveling Position

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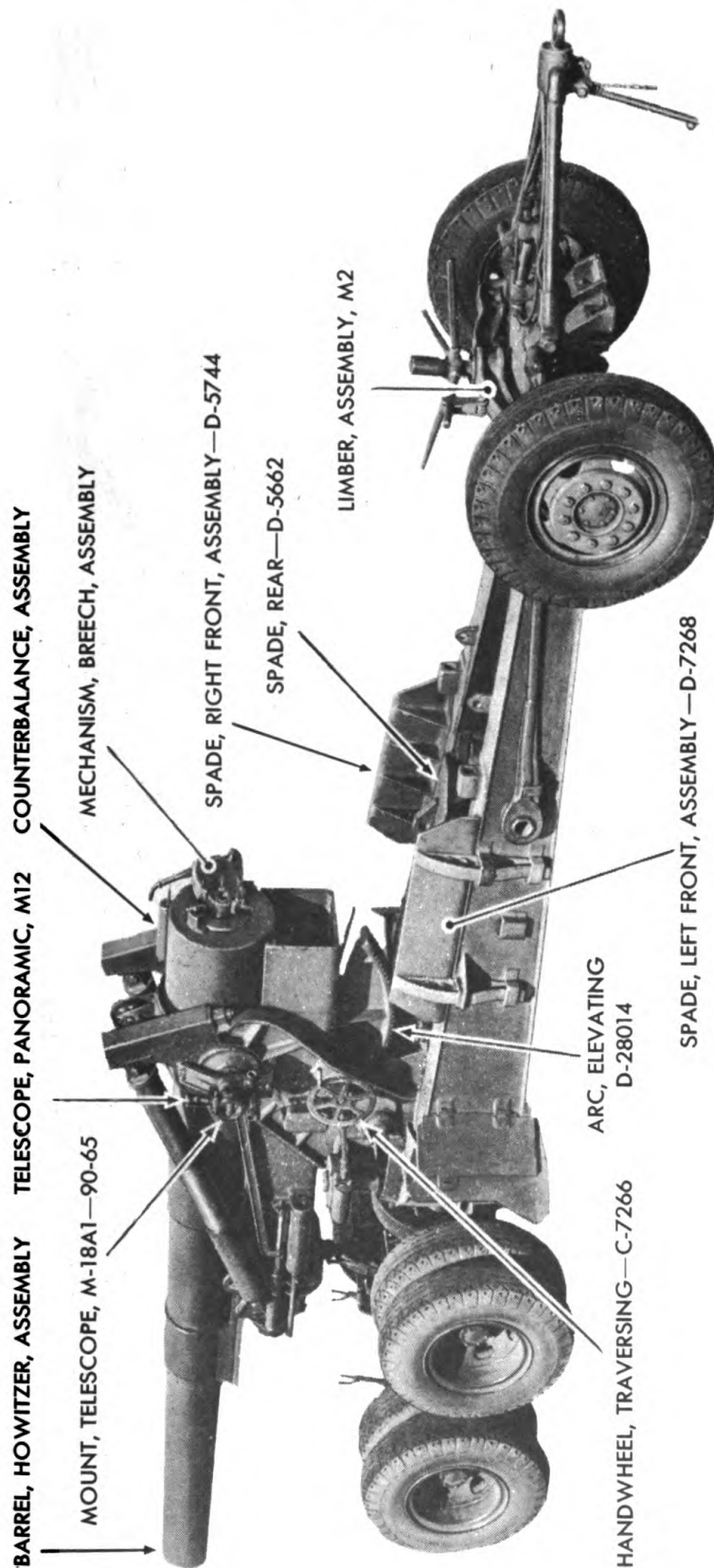
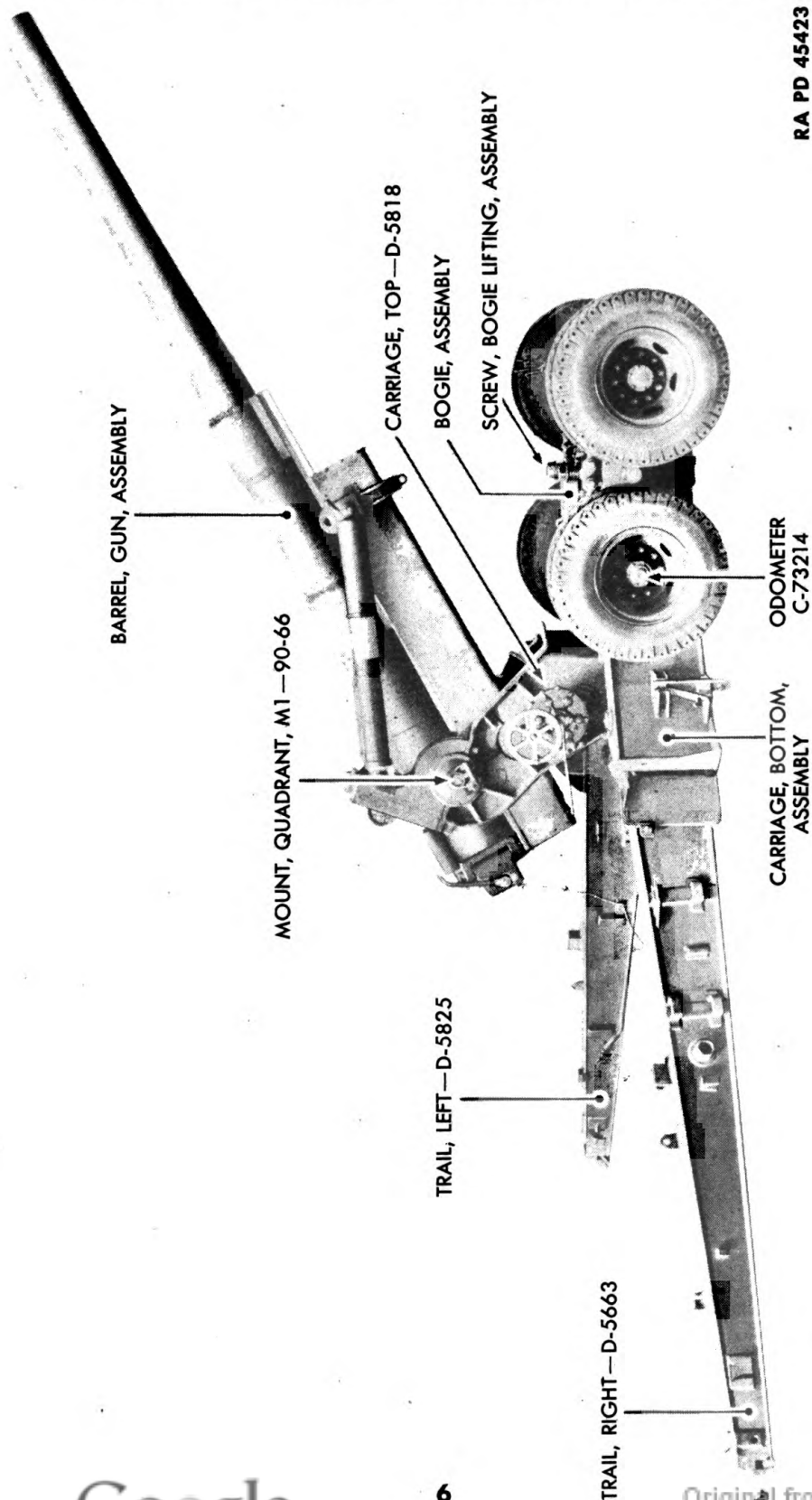


Figure 2—8-Inch Howitzer Materiel—Traveling Position

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8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



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Figure 3—155-mm Gun Materiel—Firing Position—Right Side

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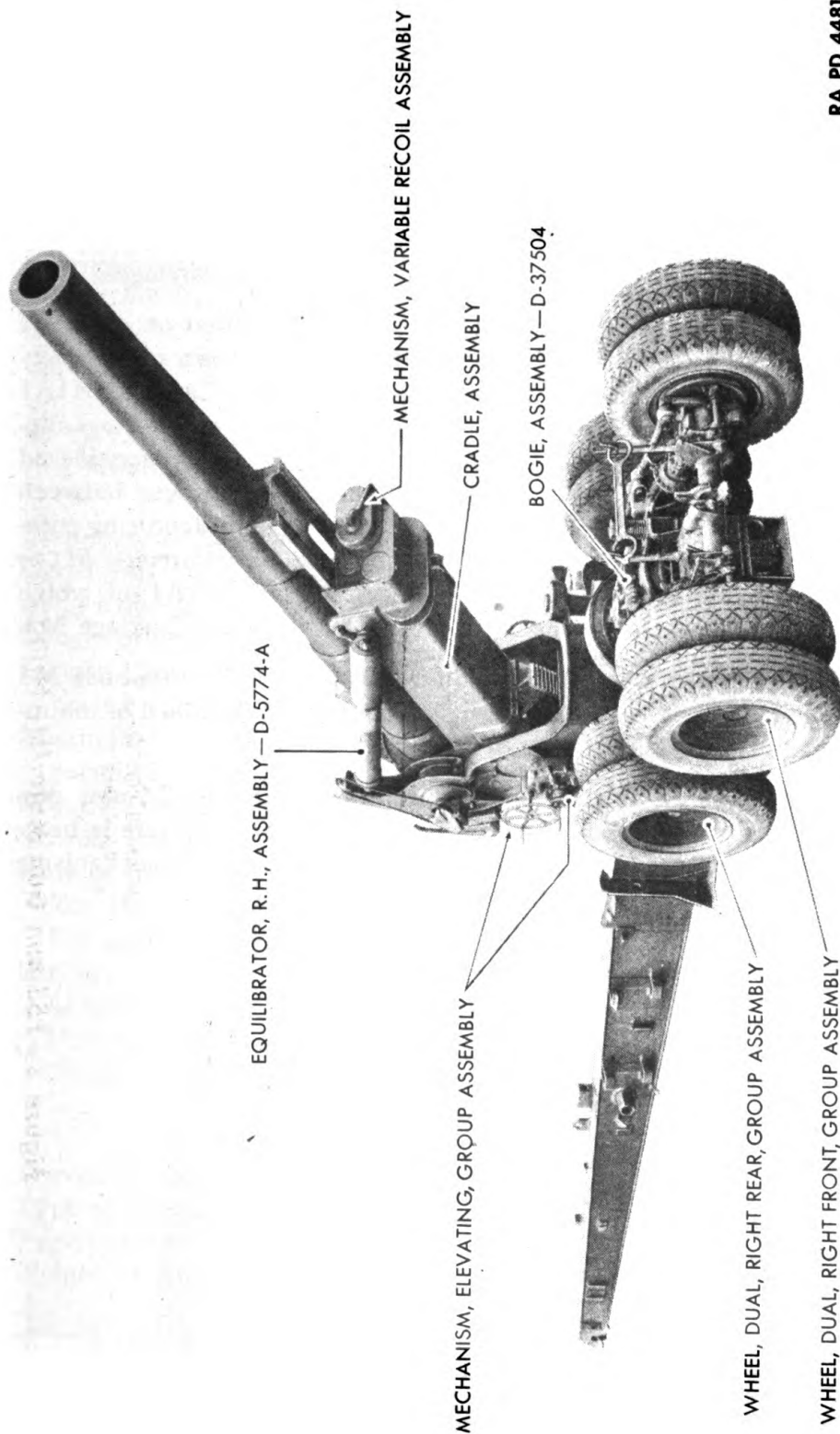


Figure 4—8-Inch Howitzer Materiel—Firing Position—Right Front

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2****3. DIFFERENCES BETWEEN THE 155-MM GUN AND CARRIAGE AND THE 8-INCH HOWITZER AND CARRIAGE**
(figs. 1, 2, 3, and 4).

a. The carriages of the 155-mm gun and 8-inch howitzer are identical in design. There were, however, a number of carriages built which cannot accommodate the 8-inch howitzer. These carriages are provided with a caution plate located directly below the name plate which says, "Do not mount 8-inch howitzer M1 on this carriage." Under no circumstances should 8-inch howitzers be mounted on these carriages.

b. The 155-mm Gun M1 or M1A1 may be mounted on either of the 155-mm Gun Carriages M1 or M1A1. For all purposes in connection with identification, use, and care, the 155-mm Gun Carriage M1A1 may be considered similar to the 155-mm Gun Carriage M1. Likewise, for the same purposes, the 155-mm Gun M1 may be considered similar to the 155-mm Gun M1A1. The detail differences between these units are minor, and affect only such parts as manufacturing components that are finished in place. *The 155-mm Gun Carriage M1 is the standard carriage for either gun.* The Carriages M1A1, of which only a few were built, were made from test models of the Carriage M1.

c. The difference between the 155-mm Gun Barrel Assemblies M1 and M1A1 is in the breech ring design. The present standard of manufacture is the Barrel Assembly M1A1 (SNL D-24).

d. The recoil mechanisms and equilibrators of the 155-mm gun and the 8-inch howitzer carriages are identical in design. There is, however, a difference in the nitrogen pressure required in these mechanisms for proper functioning.

Section II

GENERAL INFORMATION AND DATA

	Paragraph
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Limber	8
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4. WEIGHTS, DIMENSIONS, AND BALLISTICS OF THE 155-MM GUNS M1 AND M1A1 AND 8-INCH HOWITZER M1.

	155-mm Gun	8-in. Howitzer
Chamber volume	1,596 cu in.	1,485 cu in.
Density of loading	0.63	0.55
Length of bore	45 cal.	25 cal.
Length of bore	274.5 in.	200 in.
Length (muzzle to face of breech ring)	277.37 in.	202.5 in.
Maximum powder pressure permitted	40,000 lb per sq in.	33,000 lb per sq in.
Muzzle energy	5,169.5 ft-tons	5,278.4 ft-tons
Muzzle velocity	2,800 ft per sec	1,950 ft per sec
Rate of fire:		
For 10-round burst	1 round per min	1 round per min
For sustained fire	1 round per 2 min	1 round per 2 min
Rifling:		
Length	230.57 in.	164.8 in.
Number of grooves	48	64
Twist	Uniform, right hand, 1 turn for 25 cal.	Uniform, right hand, 1 turn for 25 cal.
Travel of projectile in tube	238.315 in.	173.83 in.
Type of breechblock	Interrupted screw	Interrupted screw
Type of firing mechanism	Percussion hammer	Percussion hammer
Weight of barrel	9,595 lb	10,240 lb

5. AMMUNITION.

	155-mm Gun	8-in. Howitzer
Model	M101 or M104	M106 or Mk1A1
Type	Separate loading	Separate loading
Length of projectile	26.7 in.	31 in. (approx.)

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	155-mm Gun	8-in. Howitzer
Length of propelling charge (max)	37.4 in.	21 or 24 in.
Maximum range, maximum charge:		
Elevation 844.4 mils	25,395 yd	
Elevation 807.8 mils		18,510 yd
Weight of projectile	95 lb	200 lb
Weight of propelling charge (max.)	30 lb	13.9 or 29.9 lb

6. CARRIAGE.

	155-mm Gun	8-in. Howitzer
Model	M1 or M1A1	M1
Type	Mobile, split trail	Mobile, split trail
Brakes, type	Mechanical, air-operated	Mechanical, air-operated
Dimensions in traveling position, over-all:		
Length, muzzle to lunette	34 ³ / ₈ ft	33 ¹ / ₂ ft
Width of bogie	98 ⁷ / ₈ in.	98 ⁷ / ₈ in.
Height over-all	102 ¹ / ₄ in.	102 in.
Limit of elevation:		
Maximum	63 deg 20 min or 1,126 mils	65 deg or 1,155 mils
Depression	Minus 1 deg 50 min or minus 32.6 mils	minus 2 deg or minus 35.5 mils
Limits of traverse, right or left	30 deg or 533 mils	30 deg or 533 mils
Tire size and type	11 x 20, standard	11 x 20, standard
Tire pressure	35 lb per sq in.	35 lb per sq in.
Weights:		
Gun or howitzer and carriage:		
Firing position	27,700 lb	28,000 lb
Traveling position	29,900 lb	30,200 lb
Bogie:	5,375 lb	5,375 lb
Wheel base of bogie	47 in.	47 in.
Width of tread center to center of inside bogie wheels	62 in.	62 in.
Width of tread center to center of outside bogie wheels	88 ¹ / ₂ in.	88 ¹ / ₂ in.

GENERAL INFORMATION AND DATA

7. RECOIL MECHANISM.

	155-mm Gun	8-in. Howitzer
Model	M3	M4
Maximum recoil	65 in.	70 in.
Recoil at minimum elevation		60 in.
Recoil at maximum elevation	33 in.	36 in.
Air pressure	1,820 lb per sq in.	2,000 lb per sq in.
Type of recoil mechanism	Hydraulic	Hydraulic
Type of counterrecoil mechanism	Hydropneumatic	Hydropneumatic
Oil	OIL, recoil, heavy	OIL, recoil, heavy
Oil reserve in replenisher (recoil)	1 qt	1 qt
Oil reserve in recuperator (counterrecoil)	1 qt	1 qt
Oil required to fill recoil mechanism	15 gal	15 gal
Weight		3,925 lb

8. LIMBER.

	155-mm Gun	8-in. Howitzer
Model	M2	M2
Width of tread, center to center of wheels	83 1/2 in.	83 1/2 in.
Height of lunette (limbered position)	27 in.	27 in.
Width, over-all	95 3/4 in.	95 3/4 in.
Tire size and type	11 x 20 standard	11 x 20 standard
Tire pressure	60 lb per sq in.	60 lb per sq in.
Weight	2,000 lb	2,000 lb

9. SIGHTING AND FIRE CONTROL EQUIPMENT.

a. Sighting Equipment.

	155-mm Gun	8-in. Howitzer
Aiming post	M1	M1
Aiming post light	M14	M14
Gunner's quadrant	M1	M1
Panoramic telescope	M5A5 or M12	M5A5 or M12
Telescope mount	M18A1	M18A1
Quadrant mount	M1	M1

b. Fire Control Equipment.

Aiming circle	M1	M1
B.C. telescope	M1915A1	M1915A1

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Section III

TOOLS FOR INSPECTION

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10. TOOLS FOR INSPECTION.

a. The following tools are issued to ordnance maintenance companies for use in the inspection of the 8-inch Howitzer M1 and 155-mm Guns M1 and M1A1:

Accessory parts for oil pump. Filler, oil screw, C73548	Used when the oil index of the recoil mechanism indicates that oil is required for a full reserve in the system.
Funnel, cap, w/strainer, 1/2-pt, SFAX1B	Used when replenishing oil in the recoil cylinder.
Wrench, open, 21- and 35-mm, B167298	Used to loosen or tighten the pump and bolt sleeve nuts.
Adapter, pressure gage tester, A174910	Used to connect pressure gages to tester.
Adapter, pressure gage tester, A174904	Issued with all outfits, but used only with 155-mm and 240-mm howitzer materiel.
Chest, pressure gage tester, w/contents, complete (fig. 6)	The apparatus carried in this chest (fig. 6) is used for testing accuracy of (service) gage, pressure C6385, w/connection B17128, against (master) gage, pressure, hydraulic, 0 to 200 kilograms, B748. Pressure is transmitted equally to both gages, causing gages to read the same when in adjustment. To use tester, clamp in vise by means of lug on under side (fig. 7). Withdraw screw and fill apparatus with OIL, recoil, heavy, before assembling pressure gages, to eliminate air bubbles in connections.

TOOLS FOR INSPECTION

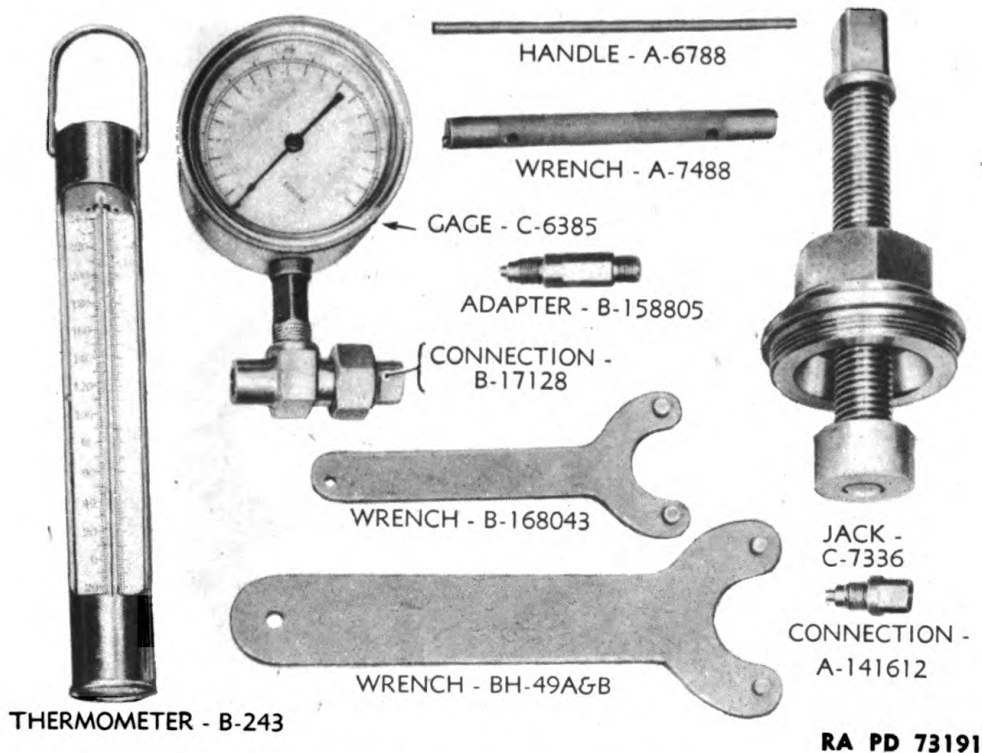


Figure 5—Tools for Recoil and Equilibrator Mechanisms

Screw master gage into one arm of tester and the gage to be tested into other arm. Apply pressure by operating screw handle and compare readings over entire range of gages. If gages are not in agreement, proceed as outlined directly below.

Adjust pressure gage by pulling hand off spindle, using gage hand jack and resetting hand in agreement with master gage (fig. 8). Use small hammer and gage hand set when resetting hand (fig. 9). Tap very lightly. Readings are between 430 and 2,300 pounds per square inch (30 to 160 kilograms per square centimeter).

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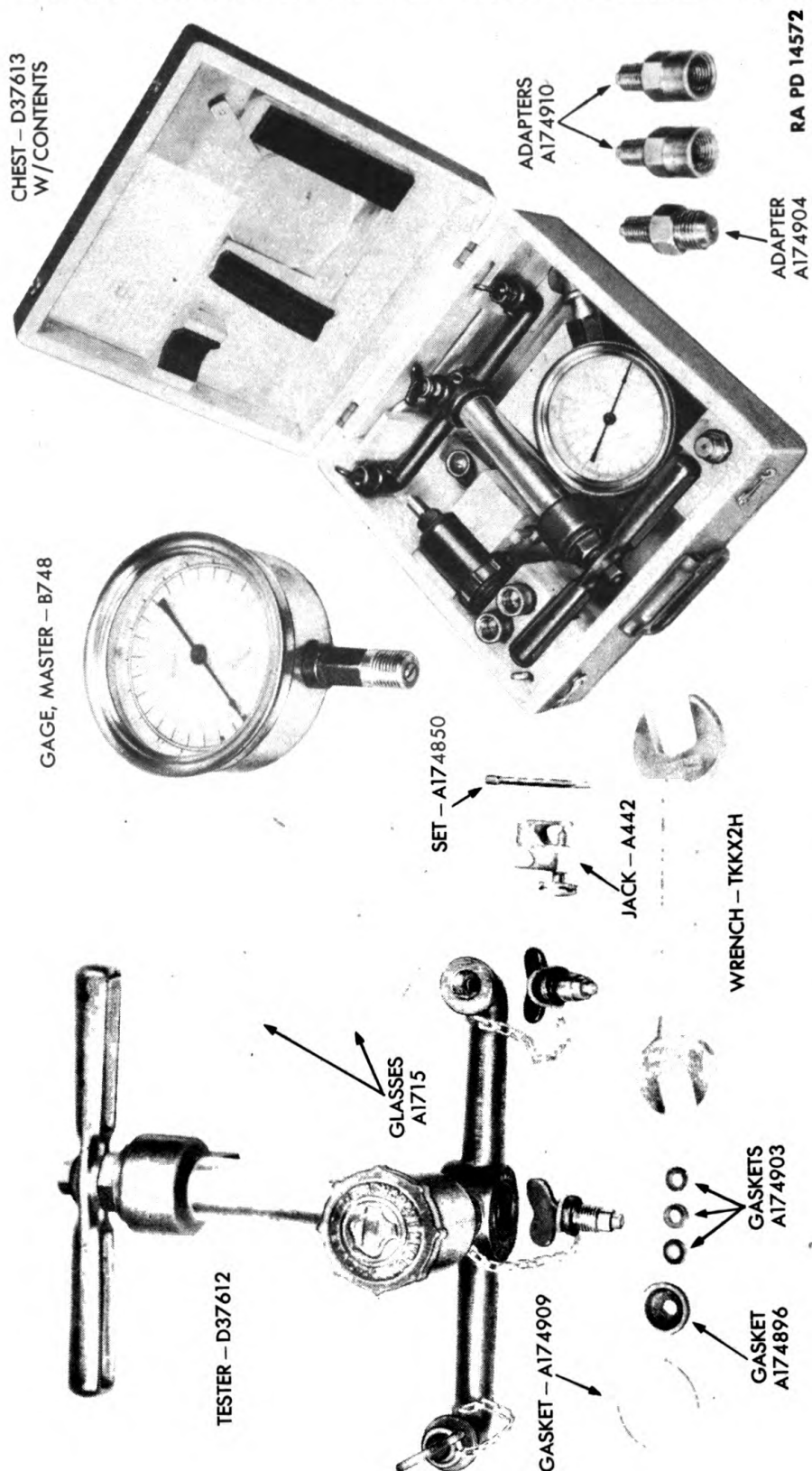
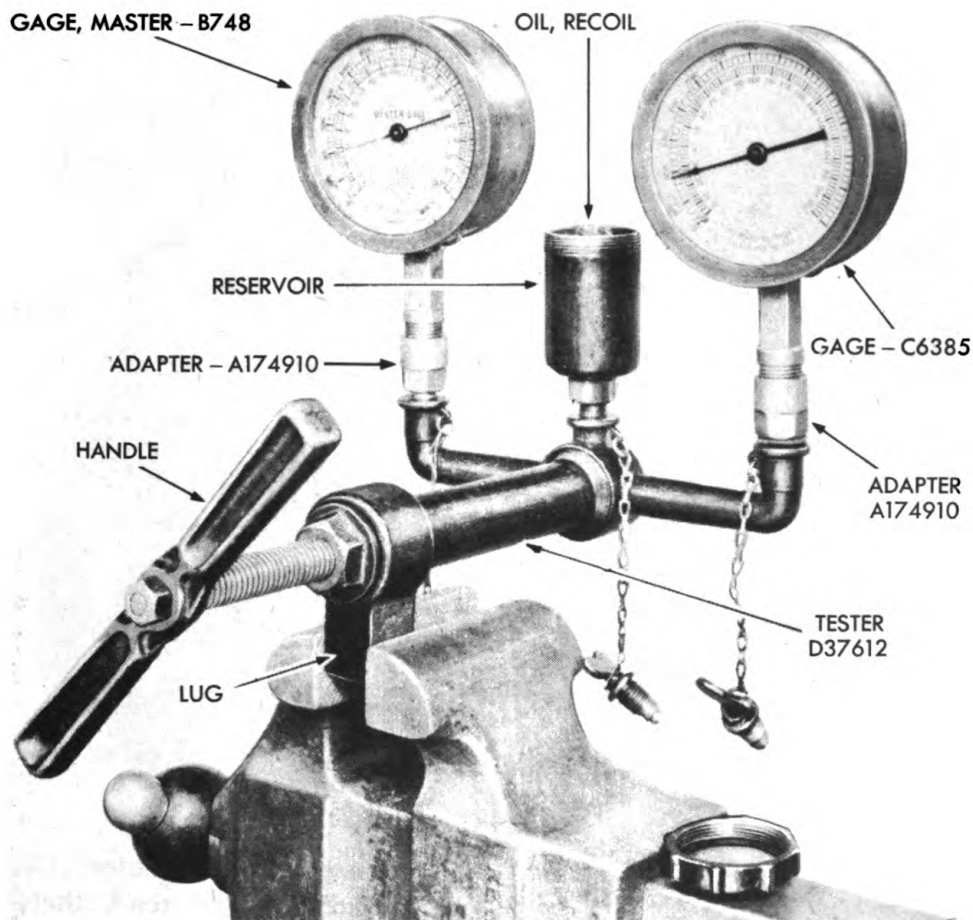


Figure 6—Pressure Gage Tester, Spare Parts, and Accessories

TOOLS FOR INSPECTION



RA PD 14708

Figure 7—Testing Pressure Gage

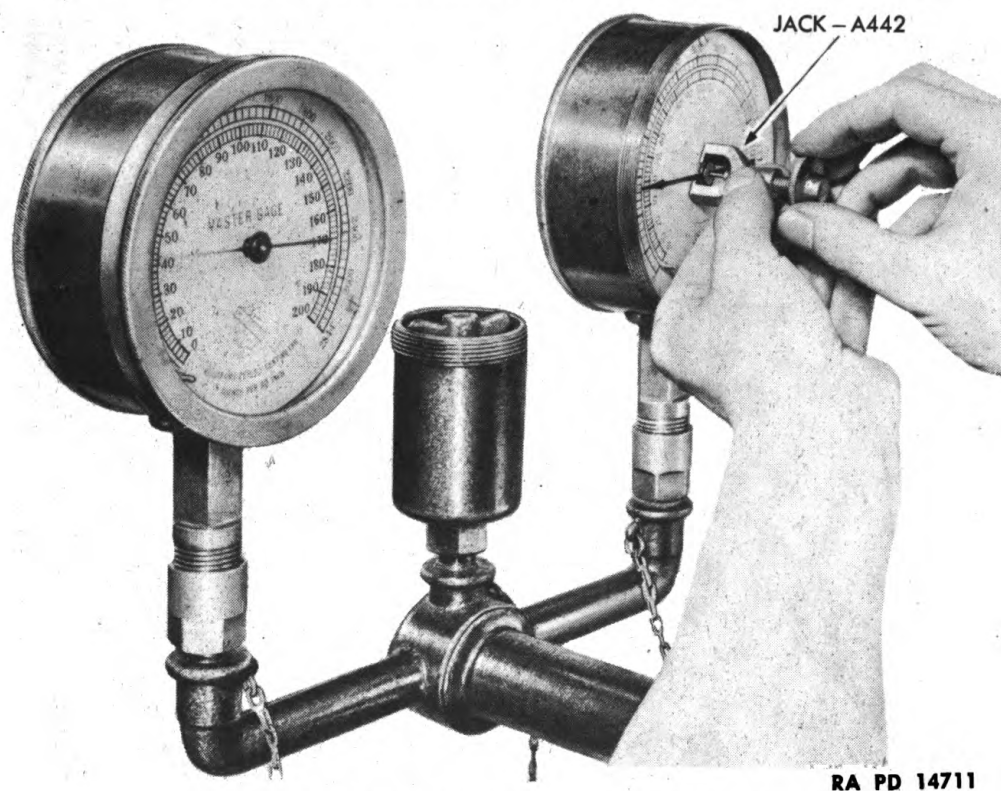
Gage, pressure, hydraulic, 0 to 200 kilograms, master, B748

Used to check accuracy of service pressure gage. It is graduated in pounds per square inch as well as kilograms per square centimeter. Gage should be returned to an arsenal once a year for verification of its accuracy. Care must be exercised not to jar instrument at any time.

Gage, pressure C6385, with connection (B17128) (fig. 5)

Used for testing gas pressure in recuperator cylinder of recoil mechanism. This gage is calibrated from zero to 2,844 pounds per square inch and from zero to 200 kilograms

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RA PD 14711

Figure 8—Removing Pressure Gage Hand

per square centimeter. Gas pressure can be read, therefore, either in pounds per square inch or kilograms per square centimeter.

Gage, tire, pressure, balloon,
A141576 (fig. 19)
Gaskets and glasses

Used for testing air pressure in bogie and limber tires.

Gasket, oil reservoir, A174909; gasket, suction piston, A174896; gasket, adapter, A174903, and glasses, gage, A1715 are spare parts.

Jack, gage hand, A442

Used to remove pressure gage indicator hand when not in agreement with master gage.

Jack, screw, recoil piston, C7336
(fig. 5)

Used with wrench, rtc., rvrs., 1½ in. sq. opng., TKDX1 (w/handle TKDX1B and gear TKDX1BA) to force the

TOOLS FOR INSPECTION

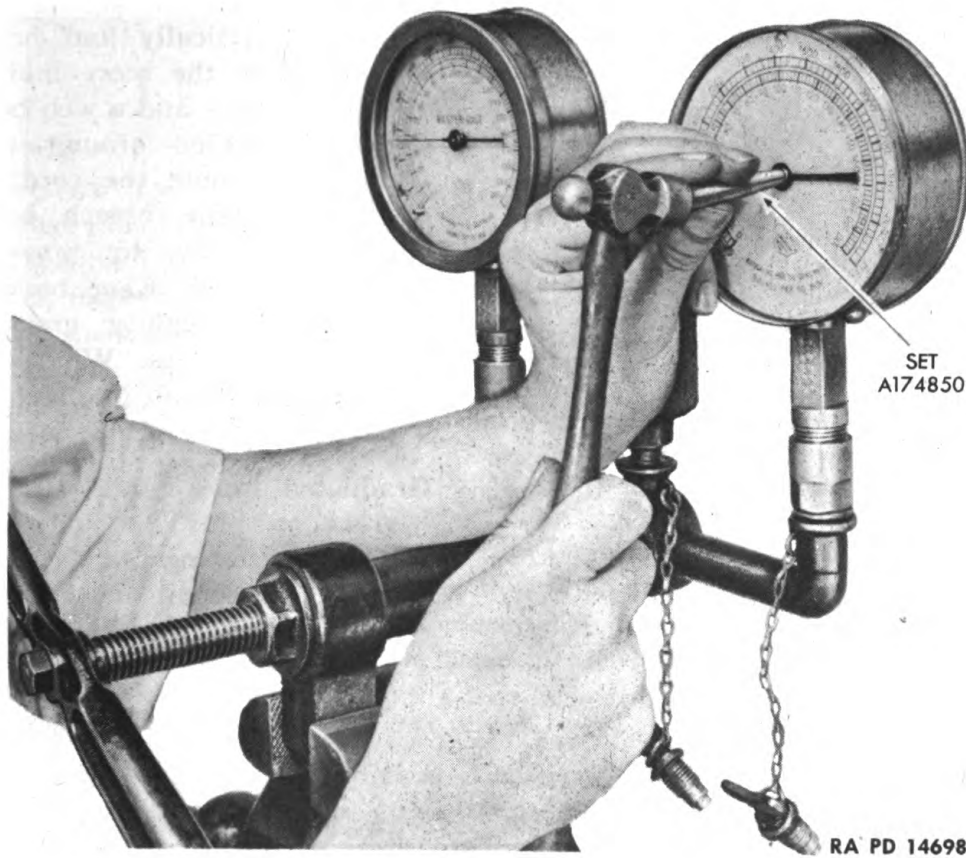


Figure 9—Resetting Pressure Gage Hand

counterrecoil piston rod to the rear when testing the recoil mechanism for pressure and friction. These operations are described in paragraph 17.

Set, gage hand, A174850

Used to place pressure gage indicator hand in agreement with master gage.

Sight, bore (for 155-mm gun and 8-inch howitzer)

Consists of breech bore sight and muzzle bore sight. The sight, bore, breech, RF11WB, is a metal disk which fits accurately in the breech chamber. The sight, bore, muzzle, RF11ED, comprises a quantity of black linen cord, to be stretched tightly across the

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muzzle, vertically and horizontally, in the score marks of the muzzle and a web belt to be buckled around the muzzle to hold the cord in place. Handle breech bore sight carefully to prevent nicks and burs. Keep breech bore sight slightly greased when not in use. Wind the cord and web belt into a compact bundle when not in use.

Thermometer, Fahrenheit, B243
(fig. 5)

Graduated from minus 10 degrees to plus 220 degrees. Used for testing temperature of oil in recoil mechanism when checking recoil air pressure.

Section IV

INSPECTION INSTRUCTIONS

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Procedure	12
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Star-gaging	14
Tubes, inspection	15
Recoil mechanism inspection	16
Manometer test	17
Restoring recoil mechanism to normal	18
Equilibrators, inspection	19

11. PURPOSE.

a. Inspection of your weapon is vital. Thorough, systematic inspection at regular intervals is the best insurance against an unexpected gun breakdown at the critical moment when maximum performance is absolutely necessary. Never let your materiel run down; keep it in first class fighting condition by vigilant inspection and prompt maintenance.

b. Inspection is for the purpose of determining the condition of the materiel, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning. Its immediate aim is trouble prevention, which includes:

- (1) Preventive maintenance.
- (2) Discovering evidence of improper treatment received by the materiel before delivery into your hands.
- (3) Determining when replacement of parts is necessary because of ordinary wear or defects in parts.

12. PROCEDURE.

Parts to Be Inspected	Points to Be Observed
Equilibrators.	Check for nitrogen pressure (par. 19). Check for proper functioning by elevating and depressing the barrel through its entire range.
Trunnion bearing caps.	Elevate and depress barrel through entire range. If binding in trunnion bearing caps is observed, disassemble, and examine all parts for wear and leakage. Replace all damaged or worn parts (par. 48).

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Parts to Be Inspected

Recoil mechanism.

Points to Be Observed

Check condition of cradle.
Examine cradle slides for scores or bruises (par. 55).
Check for proper amount of oil in recuperator (par. 16).
Check for proper amount of oil in replenisher (par. 16).
Operation of oil index (par. 16).
Operation of replenisher (par. 16).
Condition of piston and counter-recoil piston rod and nut threads.
Check relief valve in counter-recoil cylinder front head for proper operation.
Check nitrogen pressure (par. 17).
Check floating piston friction (par. 17).
Check counterrecoil piston, counterrecoil piston rod stuffing box, friction (par. 17).
Check for oil leakage (par. 16).

Traversing mechanism.

Check traversing arc and pinion for worn or damaged teeth (par. 65).
Disassemble defective mechanism; examine all parts for wear or damage, and repair (pars. 63 and 64).

Elevating mechanism.

Check clutch mechanism for slippage.
Disassemble faulty mechanism, and examine all parts for wear or damage, and repair (pars. 70, 71, and 72).

Top carriage and bottom carriage.

Look for broken or cracked welds. Examine bearing surfaces (pars. 78 and 83).

INSPECTION INSTRUCTIONS

Parts to Be Inspected	Points to Be Observed
Trails.	Look for broken or cracked welds (par. 87). Check condition of trail, hinge pins to see that they are properly lubricated (par. 87).
Lubrication (sec. XXV).	Correct lubricants used in accordance with the proper lubrication guide.
Inspection and repair tools.	Inspect each tool before and after use, and remove all burs with smooth file or oilstone. When placed in container, give light coat of OIL, engine (seasonal grade).

13. AVERAGE LIFE OF TUBE.

a. Average life of a 155-mm gun tube is approximately 2,000 rounds, and of the 8-inch howitzer, 2,500 rounds. The gun and howitzer tubes in service should be star-gaged after approximately 10 percent and 90 percent of their estimated accuracy life, and thereafter at each 10 percent during the remainder of their service.

b. In order to detect unusual wear or other irregularities in the bore, tubes are star-gaged any time an inspector may find it advisable. Decoppering of bores of tubes is prohibited at any time.

14. STAR-GAGING.

a. Instructions for star-gaging will be found in TM 9-1860.

b. When star-gaging equipment is not available, the inspection report on "diameter of the bore at a point 230.25 inches from the muzzle" for the 155-mm gun, and on "diameter of the bore at a point 164.3 inches from the muzzle" for the 8-inch howitzer must be recorded as "not taken." The point of maximum wear of the lands is 230.25 inches (gun) and 164.3 inches (howitzer) from the muzzle. If a star-gage reading of 6.110 inches is obtained (an increase of 0.010 in. over the maximum size of 6.100 in. for a new gun tube), the remaining life of the gun tube may be appraised between 925 and 1,200 rounds. If a star-gage reading of 8.010 inches is obtained (an increase of 0.010 in. over the maximum size of 8.000 in. for a new howitzer tube), the remaining life of the howitzer tube may be appraised between 1,050 to 1,500 rounds.

NOTE: The Artillery Gun Book (O.O. Form No. 5825) must accompany gun at all times, and be available to inspectors.

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a. The effect of scratches, nicks, pitting, scoring, etc., in the bore, caused by accidents, local defects of the bore and improper care are as follows: They permit leakage of gas which causes erosion of the forcing cone and rifling. They also wear away the rotating band so that the projectile does not attain its proper rotational velocity. Such defects should be smoothed and rounded; and depending on their location, character and extent, it should be determined whether such defects are apt to cause further damage due to gas leakage and wear on the rotating band. No definite rule can be used in making this decision. Guns badly scored beyond the forcing cone must be reported to the Chief of Ordnance for final action.

b. **Pastilles.** The effect of pastilles upon the safety and accuracy of the tube is thought to be negligible. However, as a precautionary measure, tubes having more than three pastilles the size of a 5-cent piece will be reported to the Chief of Ordnance.

c. **Deformation of Rifling.** Deformation of the rifling at the origin, in general, consists of sheared lands and a flow of metal in the grooves so that the pitch of the rifling for the first inch or two is considerably reduced. This is a serious defect, and tubes showing it to a marked degree are to be reported to the Chief of Ordnance.

d. **Bore Impressions.** PLASTER OF PARIS impressions are desirable for accurate measurements because the surface is harder than gutta-percha. Before making impressions, clean the surface and make all preparations prior to mixing the PLASTER OF PARIS, which sets rapidly. Mix PLASTER OF PARIS with water, thin enough to flow readily, and pour immediately, confining the material to the desired location by a wall of wood, putty, clay or other suitable substance. After pouring, allow to harden and set from 1 to 1½ hours before removal (TM 9-1860).

e. When a gun is to be stored for an extended period or to be shipped a long distance, especially if the trip is over water, the bore should be coated with COMPOUND, rust-preventive, heavy, as prescribed in TM 9-850. For ordinary protection, coat the bore with OIL, engine, SAE 10, for temperatures less than 32 F, and with OIL, engine, SAE 30, for temperatures higher than 32 F.

16. RECOIL MECHANISM INSPECTION.**a. General.**

(1) Inspection of the recoil mechanism requires full knowledge of the action of the mechanism and its technical peculiarities. It is convenient to have the piece (gun or howitzer) in battery at zero degrees elevation.

INSPECTION INSTRUCTIONS

(2) A detailed description of the construction and action of the recoil mechanism is given in TM 9-335 and TM 9-350.

(3) The recoil mechanism is inspected for:

- (a) Oil leakage.
- (b) Oil reserve.
- (c) Proper functioning of oil index.
- (d) Serviceability of the replenisher.
- (e) Leakage of nitrogen.
- (f) Pressure of compressed nitrogen.
- (g) Friction of various packings.
- (h) Condition of the gun slides and cradle ways.

(4) Efficient functioning of the recoil mechanism depends upon:

(a) Correct "oil reserve" as indicated by the position of the oil index and the position of the replenisher piston. These should be checked as outlined in subparagraphs d and f below.

(b) Proper friction between recoiling parts and correct nitrogen pressure as checked by the manometer test (par. 17).

b. Overrecoil. If overrecoil exists, check the reserve oil and make a manometer test to determine the nitrogen pressure and friction of the recoiling parts. Then, if the reserve oil pressure and frictions are correct, the recoil mechanism is out of order and should be reported to the Chief of Ordnance.

c. Oil Leakage.

(1) Remove the filling and drain plugs B155851 from the filling valve in the recuperator head and from the replenisher valve. Examine for leakage of oil through valves.

(2) Remove the counterrecoil cylinder front head (fig. 123). Check for leakage around the counterrecoil piston.

(3) Examine the face of the counterrecoil cylinder rear head for oil leakage.

(4) Check the oil index, each end of the recoil cylinder, and each end of the replenisher cylinder, for evidence of excessive oil leakage. Piston and stuffing box packings normally pass a small amount of oil which ensures lubrication. A leak at any packing that does not exceed three drops per minute immediately after firing is not considered serious. A leak at any packing of an inactive recoil mechanism should not, however, exceed one drop in 2 minutes.

d. Oil Reserve.

(1) The oil reserve (or reserve oil) is a term applied to that portion of the oil which normally separates the floating piston from the regulator. One quart constitutes a full reserve of oil. The compressed nitrogen acts to put pressure on the oil only as long as there is oil between the regulator and floating piston. When the regulator and floating piston come in contact, the reserve oil has dropped to zero.

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(2) The Oil Pumps M3 should be tested to determine the number of strokes required to pump 1 quart of oil. (One stroke is one complete cycle of the pump handle.) The oil index will reach its maximum displacement at 60 or 70 strokes of the oil pump. This does *not* constitute a full reserve of oil; continue pumping oil up to the number of strokes required to pump 1 quart of oil.

e. Proper Functioning of Oil Index.

(1) If the oil index binds, it will give an incorrect indication of the oil reserve.

(2) If the gun is fired with either an excess or a lack of reserve oil, damage will result. Therefore, particular attention should be given the oil index.

(3) When replenishing and releasing the reserve oil, note whether the index is operating properly. If the index binds and fails to move its full distance, it must be repaired (par. 56).

f. Serviceability of Replenisher.

(1) To test the operation of the replenisher, insert a scale through the opening in the replenisher guide against the replenisher piston; then release oil by screwing the filling and drain valve release into the recoil cylinder drain hole. If movement of the replenisher piston takes place, it is working satisfactorily as a gage of the amount of oil in the recoil system.

(2) The position of the replenisher piston with respect to the rear face of the replenisher cylinder determines the amount of reserve oil required to fill the recoil cylinder. Normal distance of the replenisher piston from rear face of replenisher cylinder is $5\frac{3}{4}$ inches (14.6 cm). This position indicates that a normal reserve of oil is present in the replenisher. When the piston is 4 inches (10.2 cm) or less from the rear face of replenisher, oil should be removed from the recoil cylinder. When the piston has moved in to $7\frac{7}{8}$ inches (20 cm) or more from the rear face of the replenisher, oil should be added.

g. Leakage of Nitrogen. Leakage of nitrogen past the floating piston can be detected by sputtering and a foamy appearance of the reserve oil when drained from the mechanism.

17. MANOMETER TEST.

a. Purpose of Test.

(1) The purpose of the manometer test is to:

(a) Obtain the nitrogen pressure.

(b) Obtain the friction of the floating piston.

(c) Determine the combined friction of the counterrecoil piston, counterrecoil piston rod stuffing box, and recoil piston rod stuffing box.

(2) This test must be undertaken only by specialized ordnance mechanics.

INSPECTION INSTRUCTIONS

h. General.

(1) At low temperatures the oil in the mechanism becomes sluggish. This causes greater friction in the piston and stuffing box packings, and erratic action of the oil when passing through the small throttling orifices. Therefore, nitrogen pressure readings taken with the mechanism at low temperatures are unreliable. When pressure must be tested in cold weather, both the recoil mechanism and extra recoil oil should be kept in an enclosed place and warmed to at least 50 F for 24 hours preceding the test. However, if circumstances are such that it is impossible to comply with these instructions, the following procedure may be used:

(a) Make manometer test in the prescribed manner, for nitrogen pressure only.

(b) If adequate pressure is indicated, fire one service round, noting length of recoil and time of counterrecoil.

(c) If recoil mechanism functions satisfactorily with the exception of short recoil and slow counterrecoil, firing may proceed slowly until normal action is obtained.

(2) Because the amount of nitrogen gas originally placed in the recuperator is fixed, pressure can be increased only by moving the floating piston forward to reduce volume. This will occur when an excess of oil is introduced, as may be the case when the oil index is stuck. *Make sure that the oil index is registering properly by draining reserve oil and restoring some of it.* The oil index will move *in* when oil is drained and should move *out* as the oil reserve is established. Failure of the oil index is almost invariably on the outward movement.

c. Procedure.

(1) Place the gun or howitzer in battery at zero degrees elevation.

(2) Remove the filling and drain plug B155851 from the replenisher.

(3) Insert the filling and drain valve release A1001 screwed into adapter B105455 and draw off the oil in the replenisher by turning adapter and release.

(4) Remove the filling and drain valve release.

(5) Remove the filling and drain plug B155851 from the recuperator cylinder rear head C7191 and insert oil release A1001 connected to the end of the adapter B105455.

(6) Draw off the reserve oil into a suitable receptacle by turning adapter and release. **NOTE:** Pressure in the mechanism will cause the oil to spurt out in a stream. The flow of oil will stop when the oil index recedes below the surface of the cylinder head.

(7) Place the thermometer B243 in some of the reserve oil drained from the recuperator cylinder and make a record of the temperature. Keep the thermometer out of the sun. This should represent as accurately as possible the temperature inside the recoil mechanism.

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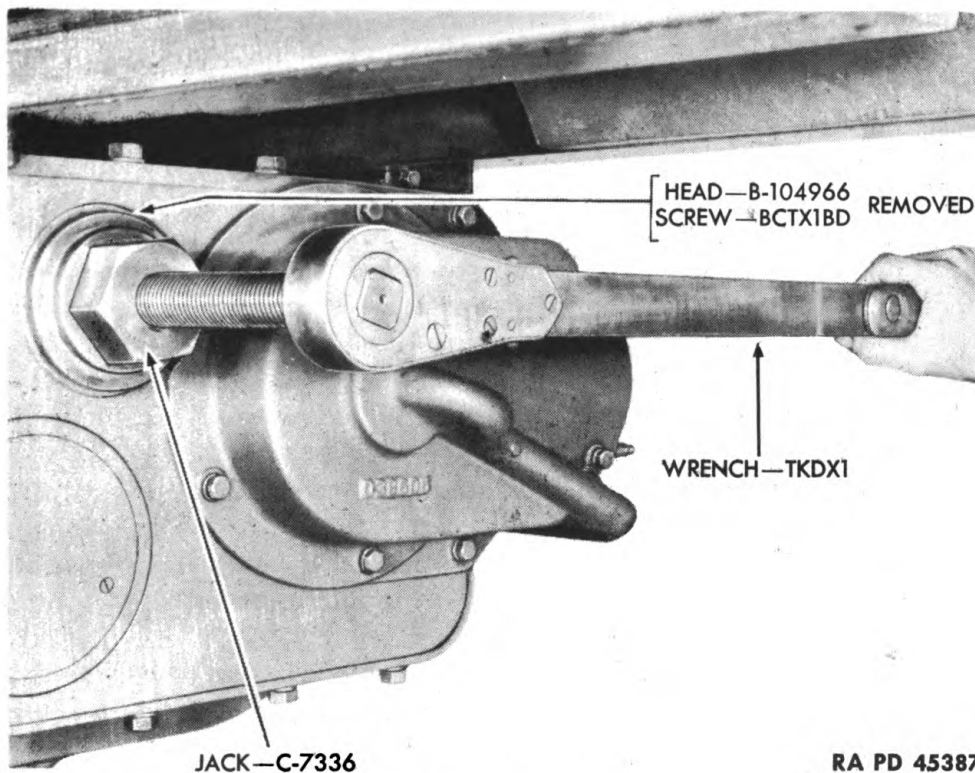


Figure 10—Using Screw Jack in Manometer Test

(8) Remove the counterrecoil cylinder front head set screw BCTX1BD and head B104966 (fig. 123).

(9) Install the recoil piston screw jack C7336 (fig. 10). Using wrench TKDX1 to turn the jack, move the counterrecoil piston rod approximately 4 inches (10.2 cm) to the rear, permitting the oil to escape through the oil release and adapter. This will cause the gun (or howitzer) barrel to move to the rear, as the barrel is still attached to the recoil mechanism.

(10) Disconnect the tube from the recoil mechanism by removing cotter pins BFAX2CR and BFAX2BD and nuts A22326 and A19824 from the recoil and counterrecoil rods (figs. 11 and 12).

(11) Screw pressure gage C6385 complete with connection B17128 (fig. 5) onto the end of adapter B105455, leaving this connection slightly loose for purging. NOTE: "Purging" means removing all air from the oil line when forcing oil in. This is done by slightly loosening one connection in the line, letting the air escape until no more air bubbles appear at the joint, then tightening the connection (fig. 13).

(12) Assemble connection A141612 to pressure gage connection B17128 and to the Oil Pump M3 connection. Pump slowly to purge the line, and then tighten all connections.

(13) MEASURING FRICTION OF RECOIL PISTON ROD STUFFING

INSPECTION INSTRUCTIONS

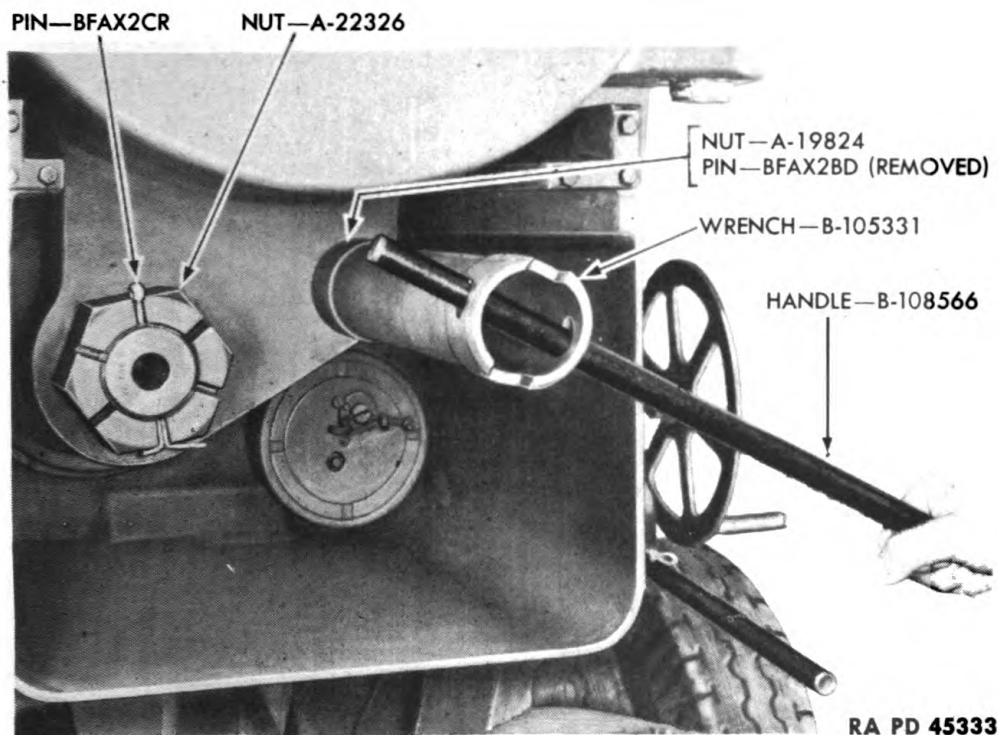
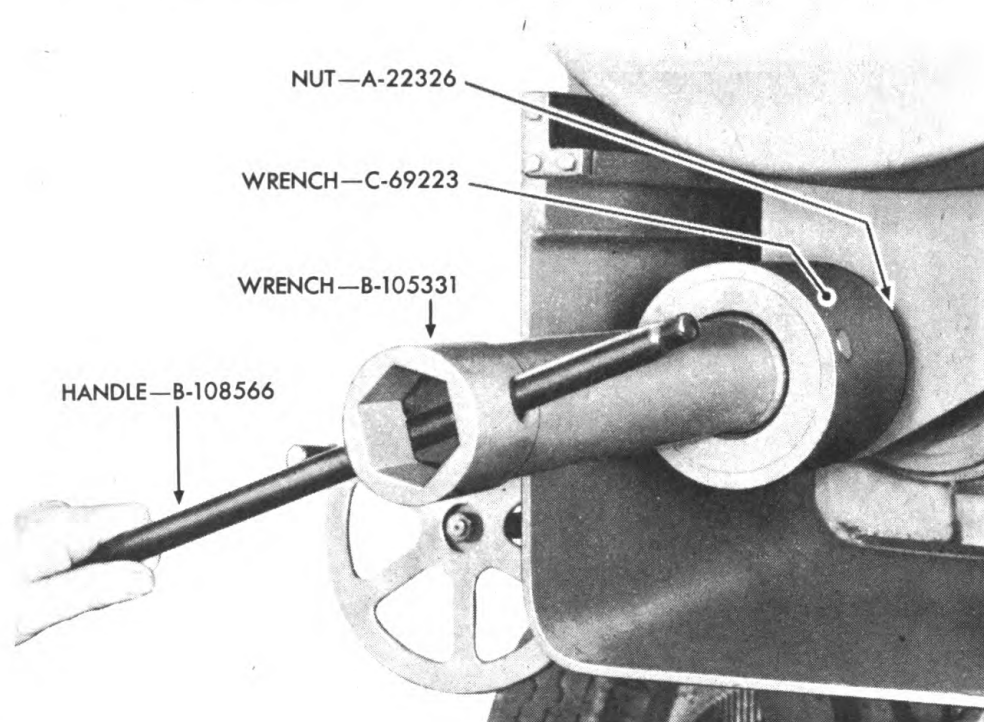


Figure 11—Removing Counterrecoil Piston Rod End Nut

BOX, COUNTERRECOIL PISTON, AND COUNTERRECOIL PISTON ROD STUFFING BOX.

- (a) Back out the screw jack.
- (b) Slowly move the recoil piston rod and the counterrecoil piston rod forward by forcing oil into the recuperator cylinder. While both rods are in motion and when the counterrecoil piston is between 3 and 4 inches from its forward position, take the gage reading.
- (c) While taking the reading, tap the gage lightly to overcome the effect of friction in the gage itself, and to get complete movement of the gage hand.
- (d) *This reading represents the combined friction of the recoil piston rod stuffing box, counterrecoil piston and counterrecoil piston rod stuffing box. Make a note of the reading.*
- (e) Obtain three uniform gage readings as above. NOTE: Exercise the counterrecoil rod a sufficient number of times to ensure that the last three gage readings are practically uniform. This is important because true friction readings cannot be obtained until the packings are well lubricated. The desired pressure necessary to overcome the combined friction is 200 pounds per square inch, for both the 155-mm gun and the 8-inch howitzer. The friction should never be below 190 pounds per square inch nor above 350 pounds per square inch.
- (14) Continue to pump oil into the recuperator cylinder slowly,

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Figure 12—Removing Recoil Piston Rod End Nut

until the recoil and counterrecoil piston rods are back in battery position and the oil index stops moving (5-mm outside the face of the head); then take gage reading. This reading ($AP + F$) represents the nitrogen pressure AP plus the floating piston friction F . Make a note of this reading.

(15) Loosen the pump connection sufficiently to allow oil to escape by drops. Observe the gage hand as the pressure drops. *Record the reading when the gage hand stops moving.* This reading ($AP - F$) represents the nitrogen pressure minus the floating piston friction.

(16) Repeat the operations outlined in steps (14) and (15) above, until three sets of readings which agree closely are obtained. Average the three sets of readings for $AP + F$ and $AP - F$, and use the average figures for calculations.

d. Calculating Nitrogen Pressure.

(1) The nitrogen pressure in the mechanism is one-half the sum of the readings obtained in subparagraph c (14) and (15) above.

$$AP = \frac{(AP + F) + (AP - F)}{2}$$

EXAMPLE:

Average gage reading as found in subparagraph c (14) above

133.5 kg per sq cm or 1,898.8 lb per sq in.

INSPECTION INSTRUCTIONS

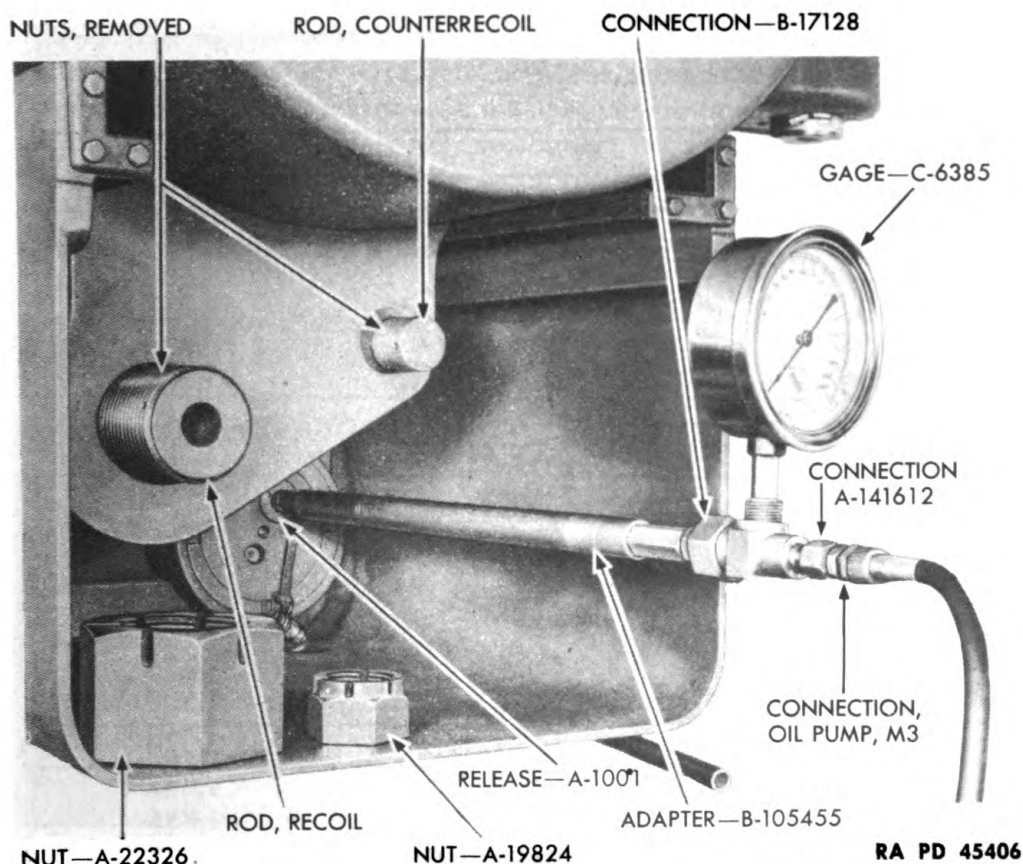


Figure 13—Manometer Test

Average gage reading as found in subparagraph c (15) above
 120.5 kg per sq cm or 1,713.9 lb per sq in.
 Add these readings together . . . 254.0 kg per sq cm or 3,612.6 lb per sq in.
 Then divide the answer by 2 . . . 127.0 kg per sq cm or 1,806.3 lb per sq in.

NOTE: 127.0 kilograms per square centimeter or 1,806.3 pounds per square inch equals nitrogen pressure of mechanism. (One kilogram per square centimeter equals 14.223 pounds per square inch.)

(2) Table I will be used to determine whether the measured pressure is acceptable. Gas pressure is considered satisfactory at 7.03 kilograms per square centimeter or 100 pounds per square inch above or below the pressure shown in the table for corresponding temperature readings. If the pressure does not come within this range, it must be reported to the Chief of Ordnance. Table I shows that at 70 F, the pressure should be 128 kilograms per square centimeter or 1,820 pounds per square inch. Allowable limits for this temperature are from 121 kilograms per square centimeter or 1,721 pounds per square inch to 135 kilograms per square centimeter or 1,920 pounds per square inch. The reading 127.0 kilograms per square centimeter or 1,806.3

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pounds per square inch falls within this range and therefore is acceptable.

(3) NITROGEN PRESSURE.

TABLE I

(155-MM GUN)

TEMPERATURE Degrees F	GAS PRESSURE	
	Kg Per Sq Cm	Lb Per Sq In.
0	111	1,576
5	112	1,598
10	113	1,615
15	115	1,632
20	116	1,649
25	117	1,667
30	118	1,684
35	119	1,701
40	121	1,718
45	122	1,735
50	123	1,752
55	124	1,769
60	126	1,786
65	127	1,803
70	128	1,820
75	129	1,837
80	130	1,855
85	132	1,872
90	133	1,889
95	134	1,906
100	135	1,922
105	136	1,940
110	138	1,957
115	139	1,974
120	140	1,992
125	141	2,009
130	142	2,026
135	144	2,043
140	145	2,060
145	146	2,077
150	147	2,094
155	149	2,112

NOTE: The initial nitrogen pressure in the mechanism is 128 kilograms per square centimeter or 1,820 pounds per square inch at 70 F without reserve oil. With reserve oil, the initial pressure will be approximately 20 to 40 pounds per square inch higher. Variation is approximately 1.21 kilograms per square centimeter or 17.2 pounds per square inch for each 5 F change in temperature.

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(4) The figures used in the example for calculating nitrogen pressure pertain to the 155-mm gun recoil mechanism. The procedure for conducting the manometer test, and for calculating nitrogen pressure of the 8-inch howitzer recoil mechanism is identical. The figures, however, will be different as the initial pressure in the 8-inch howitzer recoil mechanism is higher. Table II will be used when determining the serviceability of the 8-inch howitzer recoil mechanism.

(5) NITROGEN PRESSURE.

TABLE II

(8-IN. HOWITZER)

TEMPERATURE Degrees F	GAS PRESSURE	
	Kg Per Sq Cm	Lb Per Sq In.
0	122	1,736
5	123	1,754
10	125	1,773
15	126	1,792
20	127	1,811
25	129	1,830
30	130	1,849
35	131	1,868
40	133	1,887
45	134	1,906
50	135	1,924
55	137	1,943
60	138	1,962
65	139	1,981
70	141	2,000
75	142	2,019
80	143	2,038
85	145	2,057
90	146	2,076
95	147	2,094
100	149	2,113
105	150	2,132
110	151	2,151
115	153	2,170
120	154	2,189
125	155	2,208
130	157	2,227
135	158	2,246
140	159	2,264
145	161	2,283
150	162	2,302
155	163	2,321

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NOTE: The initial nitrogen pressure in the mechanism is 141 kilograms per square centimeter or 2,000 pounds per square inch at 70 F without reserve oil; with reserve oil, the initial pressure will be approximately 20 to 40 pounds per square inch higher. Variation is approximately 1.33 kilograms per square centimeter or 18.9 pounds per square inch for each 5 F change in temperature.

(6) When calculating the nitrogen pressure on the 8-inch howitzer recoil mechanism (same formula as outlined in subparagraph d (1) above), the result must fall between the allowable limits of plus or minus 7.03 kilograms per square centimeter or 100 pounds per square inch from the figures given in Table II above for the corresponding temperature. If not within the allowable limits, the recoil mechanism must be reported to the Chief of Ordnance.

e. Calculating Floating Piston Friction.

(1) The friction of the floating piston is one-half the difference between the readings obtained in subparagraph c (14) and (15) above.

$$F = \frac{(AP + F) - (AP - F)}{2}$$

2

(2) The desired floating piston friction for both the 155-mm gun and the 8-inch howitzer is 70 to 90 pounds per square inch. The calculated value of the friction should not be below 70 pounds per square inch nor above 350 pounds per square inch. **NOTE:** Packings which have been assembled for a considerable period of time may have high frictions. This is due to absorption of oil by the rubber packings.

(3) EXAMPLE:

Average gage reading as found in subparagraph c (14) above

133.5 kg per sq cm or 1,898.8 lb per sq in.

Average gage reading as found in subparagraph c (15) above

120.5 kg per sq cm or 1,713.9 lb per sq in.

Subtract the low reading from the high reading

13.0 kg per sq cm or 184.9 lb per sq in.

Then divide the answer by 2 6.5 kg per sq cm or 92.4 lb per sq in.

NOTE: The floating piston friction equals 6.5 kilograms per square centimeter or 92.4 pounds per square inch which comes within the allowable limits as outlined in step (2) above.

(4) Remove screw jack C7336. Be sure to have the screw of the screw jack all the way back in order to prevent the end of screw from striking against the cylinder wall and damaging it. This is important.

(5) Screw the recoil and counterrecoil rod end nuts on the rods. Tighten and secure with cotter pins (figs. 11 and 12).

(6) Screw the counterrecoil cylinder head back into place and secure with setscrew (fig. 123).

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18. RESTORING RECOIL MECHANISM TO NORMAL.

a. Disconnect the Oil Pump M3 from connection A141612 and allow reserve oil to drain until flow ceases. **NOTE:** The oil index will move out of sight before all the oil reserve has drained.

b. Remove adapter B105455, oil release A1001, connection A141612, and gage C6385 with connection B17128, and disassemble them.

c. Install adapter B158805 (fig. 5) in the filling and drain valve opening in place of oil release A1001.

d. Attach the Oil Pump M3 with connection to the adapter B158805 and after purging the line, force oil into the cylinder until the oil index starts to move out. **NOTE:** If the oil index does not move, tap it gently with a small piece of wood, as it may be binding.

e. Establish the correct reserve.

f. Remove all connections and replace the filling and drain plug.

g. Screw the adapter B158805 into place in the filling and drain hole of the replenisher valve. Connect Oil Pump M3 to adapter and force oil in until end of replenisher piston is approximately $5\frac{3}{4}$ inches in from the rear face of the replenisher. This constitutes the oil reserve for the recoil cylinder.

h. Remove adapter and oil pump connection.

i. Screw the filling and drain plug in place.

19. EQUILIBRATORS, INSPECTION.

a. To Measure the Nitrogen Pressure (fig. 14).

SAFETY PRECAUTION: The nitrogen pressure in the equilibrators is normally about 1,500 pounds per square inch. Hence, every caution in the following subparagraphs on opening valves and plugs slowly must be observed.

SAFETY PRECAUTION: It is not advisable to check the nitrogen pressure unless it is evident that the equilibrators are not functioning properly. One grain of dust under the air filling valve will render an equilibrator unserviceable.

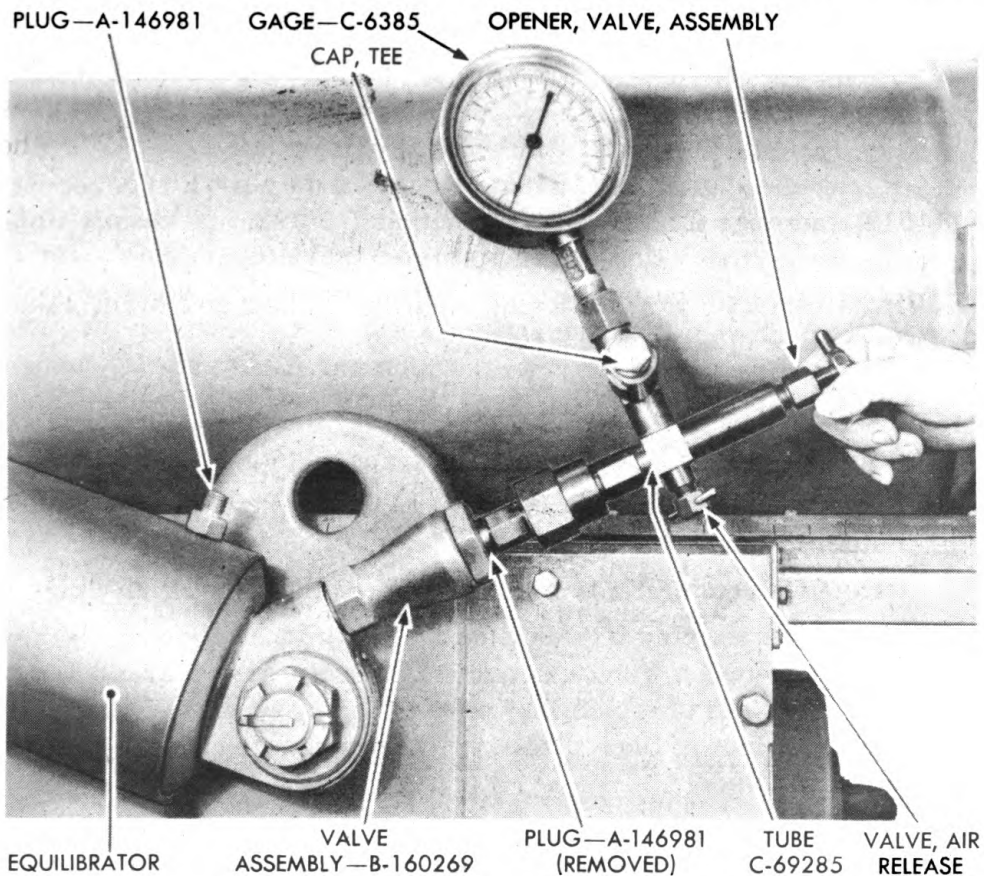
(1) With the carriage approximately level, place the gun (or howitzer) in battery and bring it to zero elevation. Check with gunner's quadrant.

(2) Remove the gas filling plug from the gas filling valve assembly in one equilibrator.

CAUTION: Remove the plug gradually to allow the escape of gas which, due to a faulty valve, may have built up a pressure against the plug.

(3) Be sure that the air release valve and the tee cap on the air fill-

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Figure 14—Checking Equilibrator Pressure

ing device are closed, and that the valve opener has been unscrewed until the point has been withdrawn into the body of the device.

(4) Screw the pressure gage in place in the air filling device.

(5) Screw the air filling device and gage into the gas filling valve assembly of the equilibrator from which the plug was removed. Before tightening the large nut on the filling device body, swing the body into such position that the tee cap will be readily accessible and the gage easily read.

(6) Force open the gas filling valve in the equilibrator by screwing in the valve opener. Tap the gage lightly to avoid error due to sticking of the hand.

(7) The pressure in the equilibrator will now be indicated on the gage. The gage reading should coincide with the pressure required for the elevation of the gun or howitzer and the atmospheric temperature as specified in Table III below. The leeway allowed is 89 pounds above the specified reading and 56 pounds below. (The tolerance on the lower limit is smaller than on the higher limit because about 15 pounds of pressure is lost during each test.)

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(8) If the pressure is more than 89 pounds above that given in the table for the charging temperature, partially open the air release valve and allow a slow escape of gas while tapping the gage lightly until the proper pressure is indicated. Close the air release valve. Unscrew the valve opener enough to close the gas filling valve. Open the air release valve slowly to let the nitrogen out of the air filling device and allow the pointer to go back to zero gradually. Remove the air filling device and gage. Install the gas filling plug and gasket (if the gasket has been removed). Tighten the plug fully.

(9) If the pressure is between the limits given in step (7) above, unscrew the valve opener enough to close the gas filling valve. Open the air release valve slowly to let the nitrogen out of the air filling device and allow the pointer to go back to zero gradually. Remove air filling device and gage. Install plug and gasket. Tighten plug.

APPROXIMATE EQUILIBRATOR NITROGEN PRESSURE AT DIFFERENT TEMPERATURES
(GAGE PRESSURE IN POUNDS PER SQUARE INCH)
TABLE III

TEMPERATURE (DEGREES FAHRENHEIT)	WEAPON AT ZERO DEGREES ELEVATION EQUILIBRATOR EXTENDED	
	(For 155-mm Gun)	(For 8-in. Hqwitzer)
0	1,308	1,174
10	1,337	1,200
20	1,366	1,226
30	1,395	1,252
40	1,423	1,278
50	1,452	1,304
60	1,481	1,330
70	1,510	1,355
80	1,539	1,381
90	1,567	1,407
100	1,596	1,433
110	1,625	1,459

b. **To Add Nitrogen to the Equilibrator.** If the pressure is more than 56 pounds below the desired pressure, proceed as follows:

(1) Unscrew the valve opener enough to close the gas filling valve. Open the air release valve slowly and allow the pointer to go back gradually to zero.

(2) Remove the cap from the nitrogen cylinder. Use special cap removing tool or insert a metal bar in the slot in the cap. Connect one end of the flexible filling tube to the tee on the air filling tube and the other end to the nitrogen cylinder valve. Be sure the air release valve is closed. Open the cylinder valve very slowly, tapping the gage lightly until it registers. The pressure of the nitrogen cylinder registered on

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the gage should exceed the desired pressure in the equilibrator, as specified in Table III.

(3) Close the cylinder valve. Screw in the valve opener, just far enough to allow the gage to register the pressure of the equilibrator. Tapping the gage lightly, slowly open the nitrogen cylinder valve to allow nitrogen to enter the equilibrator.

(4) When the pressure gage indicates a pressure slightly in excess (from 10 to 40 pounds) of that specified in the table for the temperature at which the filling operation is taking place, close the nitrogen cylinder valve.

(5) Unscrew the valve opener enough to close the gas filling valve on the equilibrator. Open the air release valve slowly. Remove the flexible filling tube assembly from the air filling tube. Close the air release valve and replace the tee cap on the air filling tube. Remove the air filling device and put in the gas filling plug, noting that the gasket is in good condition.

(6) Remove the pressure gage from the air filling tube. Remove the flexible filling tube from the nitrogen cylinder. Make sure that the nitrogen cylinder valve is entirely closed and replace the cylinder cap.

c. Proceed in the manner described in subparagraph a above, to measure the nitrogen pressure in the other equilibrator and, if necessary, to replenish the equilibrator (subpar. b).

d. If an equilibrator has a slow leak, it may be replenished as necessary. If the equilibrator has a leak so large that it is impractical to keep the nitrogen in the equilibrator at the proper pressure, return the equilibrator to a base shop for repairs.

e. To Relieve Accumulated Nitrogen in the Head.

(1) With the gun (or howitzer) at zero elevation, gradually unscrew one of the two screw plugs in rear head of equilibrator.

CAUTION: The plug should be unscrewed slowly to allow any accumulated gas to escape gradually and thus avoid the danger of gas rushing out and causing damage.

(2) Elevate the gun (or howitzer) to maximum elevation and replace plug. Be sure the plug is tight.

Section V

MAINTENANCE AND REPAIR INSTRUCTIONS

	Paragraph
General	20
Allocation of maintenance duties by echelons	21

20. GENERAL.**a. Maintenance.**

(1) In this manual the howitzer and carriage are first disassembled into major units. Then, each unit is completely disassembled and assembled. Malfunctions are described and the corrective procedure prescribed for each unit.

(2) Many repairs and adjustments can be made to major units which constitute the materiel without complete disassembly of the howitzer (or gun) and carriage. For repair procedure on individual carriage and howitzer (or gun) units, refer to paragraphs 33 to 113, inclusive, and for repair procedure on the limber, refer to paragraphs 121 to 125, inclusive.

b. Assembly of Subassemblies. When performing complete carriage and howitzer (or gun) assembly, all subassemblies must be assembled before attempting to mount them. As a part of all assembly and mounting operations, clean and lubricate the bearings, slide surfaces, threads, etc. All other parts to be assembled must be free from rust and dirt. Rough spots must be smoothed by use of a smooth file, emery cloth, or an oilstone. Burs and sharp edges must be removed.

c. Except in emergencies, work requiring welding, riveting, and the making of new parts for major replacements, will not be undertaken in the field.

d. Use only wrenches that fit snugly on parts. Tools that do not fit well fail or cause damage to the corners of nuts, bolt heads, etc.

e. Cotter pins must be spread properly after installation. Bolts, screws, and nuts must be tight and safeguarded properly with lock washers or cotter pins. Screws drilled for locking wires must be wired securely.

f. When replacing bushings, remove all burs which may exist in and around the hole. Fit the new bushing to enter a short distance into the hole. Lubricate the exterior of the bushing and, if possible, place a bolt with washers on both ends through the bushing and the hole, and draw the bushing into place by tightening the bolt nut. If the bushing is in such a position that the above procedure cannot be followed, place a piece of hardwood against the end of bushing and drive it into place with a hammer. Ream the bushing to the desired fit after installation.

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g. Operations covered in TM 9-335 and TM 9-350 are sometimes performed by the ordnance maintenance personnel, who should refer to TM 9-335 and TM 9-350 for proper instructions covering these operations.

**21. ALLOCATION OF MAINTENANCE DUTIES BY
ECHELONS.**

a. **Definitions.** Echelons and words as used in this list of maintenance allocations are defined as follows:

SECOND ECHELON: Line organization regiments, battalions, companies, detachments, and separate companies (first and second echelons).

THIRD ECHELON: Ordnance light maintenance companies, ordnance medium maintenance companies, ordnance divisional maintenance battalions, and post ordnance shops.

FOURTH ECHELON: Ordnance heavy maintenance companies, and service command shops.

FIFTH ECHELON: Ordnance base regiments, ordnance bases, arsenals, and manufacturers' plants.

SERVICE: Consists of servicing, cleaning, lubricating, tightening bolts and nuts, and making external adjustments of subassemblies or assemblies and controls.
(Including preventive maintenance)
(par. 23 a (1) and (2), AR 850-15 (6 Oct. 42))

REPLACE: Consists of removing the part, subassembly, or assembly from the vehicles, and replacing it with a new or reconditioned or rebuilt part, subassembly, or assembly, whichever the case may be.
(par 23 a (4) AR 850-15 (6 Oct. 42))

REPAIR: Consists of making repairs to, or replacement of the part, subassembly or assembly that can be accomplished without completely disassembling the subassembly, or assemblies, and does not require heavy welding, or riveting, machining, fitting, and or alining or balancing.
(par. 23 a (3) and (5), in part, AR 850-15 (6 Oct. 42))

REBUILD: Consists of completely reconditioning and replacing in serviceable condition any unserviceable part, subassembly, or assembly of the vehicle, including welding, riveting, machining, fitting, alining, balancing, assembling, and testing.
(par. 23 a (5), in part, and (6), AR 850-15 (6 Oct. 42))

MAINTENANCE AND REPAIR INSTRUCTIONS

b. Maintenance Allocations.

GUN OR HOWITZER BARREL ASSEMBLY (AS A UNIT)	2nd	ECHELONS		
		3rd	4th	5th
Barrel assembly—replace		x	x	
Barrel assembly—service (clean)	x	x	x	
GUN OR HOWITZER BARREL				
Bore—star gage		x	x	
Bore—take impressions (plaster of Paris or gutta-percha)		x	x	
Hoops—replace				x
Rails—repair		x	x	
Rails—replace				x
Scale—repair or replace		x	x	
Strip—repair or replace		x	x	
BREECH RING				
Arc, breechblock control—repair or replace		x	x	
Bracket, counterbalance—repair or replace		x	x	
Cam, breechblock rotating—repair or replace		x	x	
Hook, retracting—replace	x	x	x	
Plates, leveling—repair		x	x	
Plates, leveling—replace			x	x
Ring, breech—repair		x	x	
Ring, breech—replace				x
Stop, gun—replace	x	x	x	
FIRING MECHANISM M1				
Assembly, firing mechanism M1—replace or service	x	x	x	
Block, firing mechanism—repair		x	x	
Guide, firing pin—repair		x	x	
Handle, block—repair		x	x	
Holder, primer—repair		x	x	
Holder, primer—replace	x	x	x	
Housing, firing pin—repair		x	x	
Pin, firing—replace	x	x	x	
Plunger, block—repair		x	x	
Spring, block plunger—replace	x	x	x	
Spring, firing pin—replace	x	x	x	
BREECH MECHANISM				
Bearing, breechblock operating lever—repair or replace		x	x	
Block, breechblock operating lever catch spring—repair		x	x	
Block, breechblock operating lever catch spring—replace	x	x	x	

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

BREECH MECHANISM (Cont'd)	ECHELONS			
	2nd	3rd	4th	5th
Bolt, retaining, breechblock operating lever bearing—repair		x	x	
Bolt, retaining, breechblock operating lever bearing—replace	x	x	x	
Breechblock, assembly—replace or service	x	x	x	
Breechblock—repair		x	x	
Bushing, obturator spindle vent—replace		x	x	
Carrier, breechblock, assembly—repair or replace		x	x	
Catch, breechblock operating lever—replace	x	x	x	
Crankshaft—repair or replace		x	x	
Crosshead—repair		x	x	
Crosshead—replace	x	x	x	
Detent, firing mechanism safety plunger housing lock—replace	x	x	x	
Disk, filling-in—repair		x	x	
Disk, filling-in—replace	x	x	x	
Gasket, obturator spindle plug—replace		x	x	
Hammer, percussion—repair		x	x	
Hammer, percussion—replace	x	x	x	
Handle, firing mechanism safety plunger—replace	x	x	x	
Housing, firing mechanism receiver—repair		x	x	
Housing, firing mechanism receiver—replace	x	x	x	
Housing, firing mechanism safety plunger—repair or replace		x	x	
Key, breechblock carrier—repair or replace		x	x	
Knob, percussion hammer locking pin—replace	x	x	x	
Lever, breechblock operating—repair		x	x	
Lever, breechblock operating—replace	x	x	x	
Lock, firing mechanism safety housing—repair or replace		x	x	
Mechanism, breech (as a unit)—service	x	x	x	
Pad, gas check (obturator)—replace	x	x	x	
Pin, hinge, assembly—repair or replace		x	x	
Pin, locking, percussion hammer—replace	x	x	x	
Pin, percussion hammer hinge—replace	x	x	x	
Pin, retaining, breechblock operating lever catch spring block—replace	x	x	x	
Plate, breechblock operating lever catch—repair or replace		x	x	
Plug, obturator spindle—replace		x	x	
Plunger, firing mechanism safety—replace	x	x	x	
Ring, breechblock carrier retainer—repair or replace		x	x	

MAINTENANCE AND REPAIR INSTRUCTIONS

	BREECH MECHANISM (Cont'd)	2nd	ECHELONS		
			3rd	4th	5th
Ring, inner (obturator)—replace		x	x	x	
Ring, split, front (obturator)—replace		x	x	x	
Ring, split, rear (obturator)—replace		x	x	x	
Roller, breechblock—repair			x	x	
Roller, breechblock—replace		x	x	x	
Spindle, obturator, assembly—replace		x	x	x	
Spindle, obturator—repair			x	x	
Spring, breechblock operating lever catch—replace		x	x	x	
Spring, firing mechanism safety plunger—replace		x	x	x	
Spring, firing mechanism safety plunger housing lock detent—replace		x	x	x	
Spring, obturator spindle—replace		x	x	x	
Spring, percussion hammer locking pin—replace		x	x	x	
COUNTERBALANCE					
Counterbalance, assembly—repair			x	x	
Counterbalance, assembly—replace or service		x	x	x	
EQUILIBRATORS (AS A UNIT)					
Adjust, for temperature only		x	x	x	
Check for pressure		x	x	x	
Rebuild					x
Repair			x	x	
Replace			x	x	
CARRIAGE (AS A UNIT)					
Carriage—service or paint		x	x	x	
Fittings, lubrication—service or paint		x	x	x	
TRUNNION BEARING CAPS (AS A UNIT)					
Service		x	x	x	
Repair			x	x	
Replace			x	x	
RECOIL MECHANISM					
Arc, elevating—repair or replace			x	x	
Bracket and sheave—repair			x	x	
Bracket and sheave—replace		x	x	x	
End, counterrecoil piston rod—repair or replace			x	x	
End, recoil piston rod—repair or replace			x	x	
Follower, counterrecoil piston—adjust only			x	x	
Follower, counterrecoil piston—adjust or replace			x	x	
Follower, oil index—adjust or replace			x	x	
Gasket, filling plug, recuperator head and replenisher—replace		x	x	x	
Gasket, filling valve, recuperator head and replenisher—replace		x	x	x	
Gland, oil index—replace			x	x	

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

		ECHELONS			
		2nd	3rd	4th	5th
RECOIL MECHANISM (Cont'd)					
Head, counterrecoil cylinder front assembly—					
repair or replace			x	x	
Index, oil—check operation	x	x	x		
Index, oil—repair			x	x	
Leakage, oil—check	x	x	x		
Leakage, oil—correct			x	x	
Manometer test:			x	x	
Nitrogen pressure					
Floating piston friction					
Counterrecoil piston, counterrecoil piston rod					
stuffing box, and recoil piston rod stuffing					
box friction					
Mechanism, recoil—repair					x
Mechanism, variable recoil—repair or replace			x	x	
Oil—change			x	x	
Oil reserve, recuperator and replenisher—check,					
drain, and fill	x	x	x		
Packing, oil index—replace			x	x	
Pins, cradle trunnion—repair or replace			x	x	
Plugs, filling, recuperator and replenisher—replace	x	x	x		
Replenisher, oil—repair or replace			x	x	
Retainer, counterrecoil cylinder wiper—replace			x	x	
Retainer, drain valve—replace			x	x	
Slides, cradle—repair			x	x	
Spring, filling valve—replace			x	x	
Spring, oil index packing—replace			x	x	
Valve, counterrecoil cylinder head relief—replace			x	x	
Valve, filling, recuperator and replenisher—replace			x	x	
Wiper, counterrecoil cylinder—replace			x	x	
Wiper, counterrecoil rod—replace			x	x	
Yoke, recoil and counterrecoil piston rod—repair					
or replace			x	x	
TRAVERSING MECHANISM (AS A UNIT)					
Service	x	x	x		
Rebuild					x
Repair			x	x	
Replace			x	x	
ELEVATING MECHANISM (AS A UNIT)					
Service	x	x	x		
Rebuild					x
Repair			x	x	
Replace			x	x	

MAINTENANCE AND REPAIR INSTRUCTIONS

	TOP CARRIAGE (AS A UNIT)	ECHELONS			
		2nd	3rd	4th	5th
Service	X	X	X		
Rebuild					X
Repair			X	X	
Replace			X	X	
BOTTOM CARRIAGE (AS A UNIT)					
Service	X	X	X		
Rebuild					X
Repair			X	X	
Replace			X	X	
TRAILS (AS A UNIT)					
Service	X	X	X		
Rebuild					X
Repair			X	X	
Replace			X	X	
TRAIL SPADES					
Spades, front—repair			X	X	
Spades, front—replace as a unit	X	X	X		
Spades, front—replace supports	X	X	X		
Spades, rear—repair			X	X	
Spades, trail—replace as a unit	X	X	X		
BOGIE (AS A UNIT)					
Service	X	X	X		
Rebuild					X
Repair			X	X	
Replace	X	X	X		
LIMBER M2 (AS A UNIT)					
Service	X	X	X		
Rebuild					X
Repair			X	X	
Replace (as a unit)	X	X	X		
Replace, parts			X	X	
BRAKE MECHANISM (AS A UNIT)					
Service	X	X	X		
Rebuild				X	
Repair			X	X	
Replace			X	X	
WHEELS AND TIRES					
Service	X	X	X		
Repair, tires	X	X	X		
Repair, wheels			X	X	
Replace, tires	X	X	X		
Replace, wheels	X	X	X		

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

Section VI

TOOLS FOR MAINTENANCE AND REPAIR

	Paragraph
Special repair tool chest	22
Special tools	23
Improvised tools	24

22. SPECIAL REPAIR TOOL CHEST.

a. Special repair tools for maintenance of the 155-mm gun and 8-inch howitzer materiel are listed in SNL D-14, section I b. Special repair tools for this materiel are carried in special repair tool chest D7519 (fig. 15).

b. Tools of special design, not commonly used, are described and their uses outlined in the paragraphs that follow.

23. SPECIAL TOOLS.

Adapter, equilibrator, B291711 (fig. 17)	Used when removing and installing equilibrator assemblies.
Extractor, replenisher piston, 15-5-379 (fig. 22)	For removing and installing the piston in the replenisher.
File, breech thread, B141012 (fig. 16)	Used for removing burs from breech and breechblock threads.
Hose, synthetic rubber, B221731	Used with Oil Pump M3 when removing and installing equilibrator assemblies.
Puller, gear, C74750 (fig. 19)	Used when removing elevating gear from elevating gear shaft.
Puller, trail hinge pin, C76030 (fig. 20)	Used when removing trail hinge pins from bottom carriage and trails.
Reamer, resizing, primer seat, A175579 (fig. 16)	For resizing and cleaning primer seat.
Tap, gage, obturator spindle vent bushing seat, B167299 (fig. 16)	For retapping the vent bushing seat of the obturator spindle when installing a new bushing.
Tool, pintle remover, C76080 (fig. 21)	Used when removing pintle to separate top and bottom carriages.
Tube, drain equilibrator, B291710 (fig. 18)	Used with Oil Pump M3 when removing and installing equilibrator assemblies.

TOOLS FOR MAINTENANCE AND REPAIR

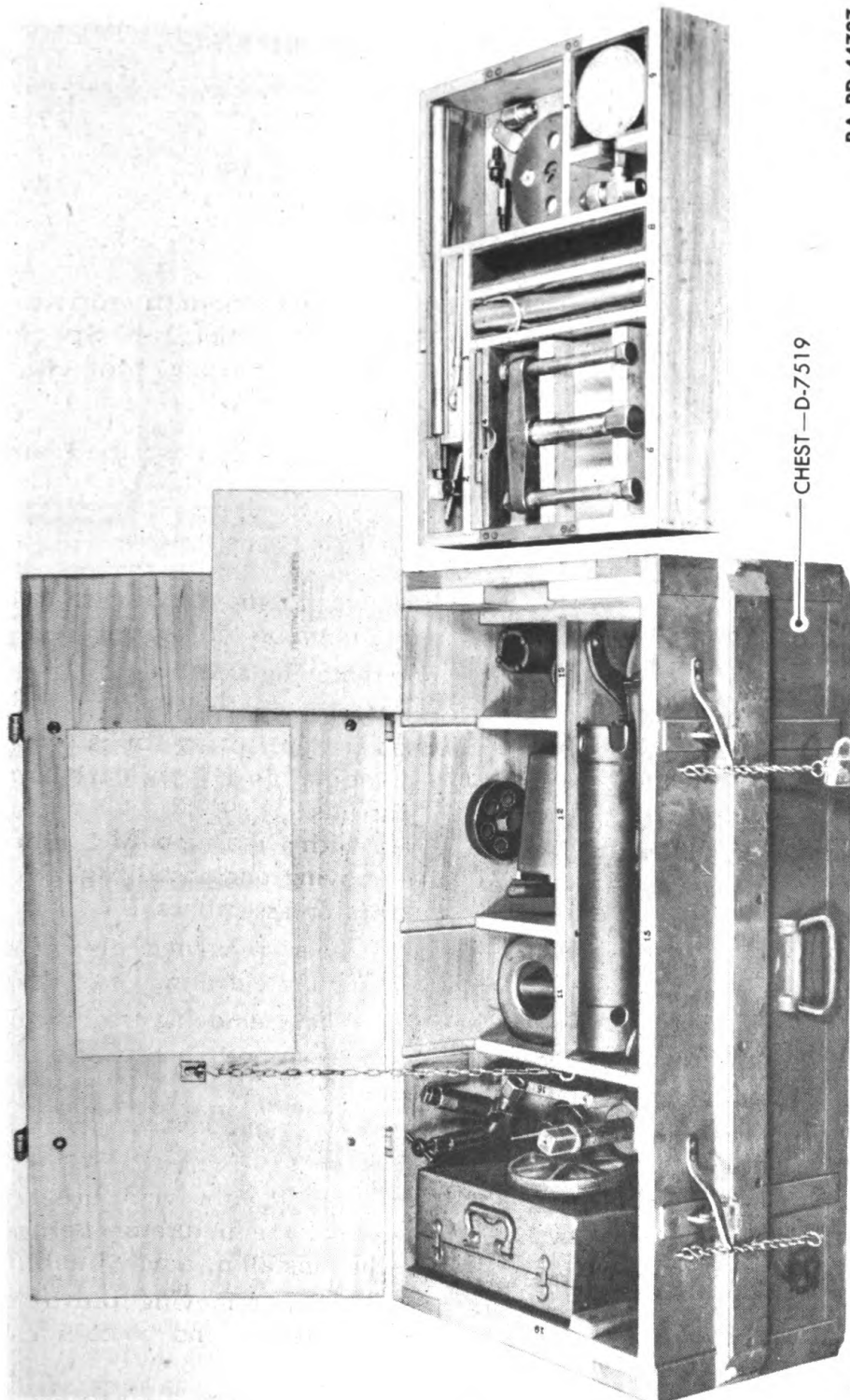


Figure 15—Special Repair Tools with Chest

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

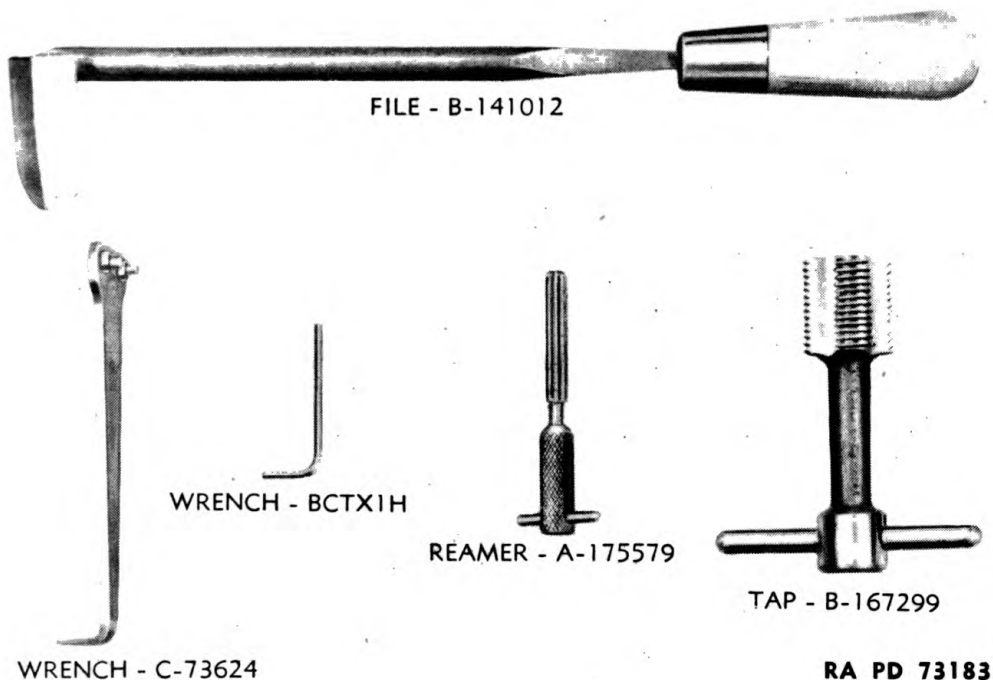


Figure 16—Breech and Firing Mechanism Tools

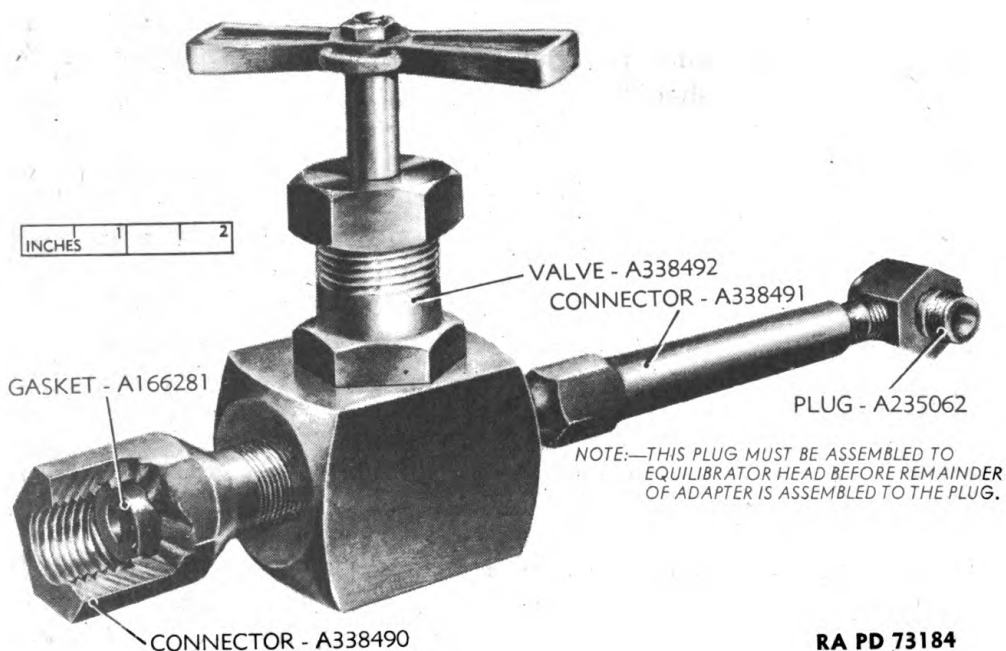
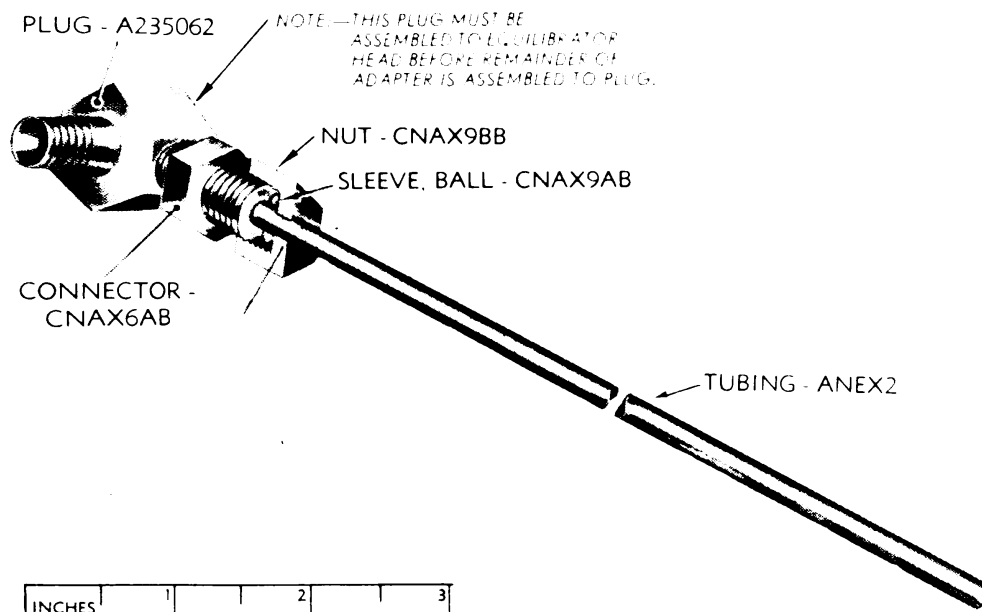


Figure 17—Equilibrator Adapter B291711

TOOLS FOR MAINTENANCE AND REPAIR



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Figure 18—Equilibrator Drain Tube B291710

Wrench, bogie lifting screw pilot, B105445 (fig. 19)

Used when removing and installing bogie lifting screw pilot in lifting screws.

Wrench, bogie trunnion nut and lifting screw shackle pin, B105336 (fig. 19)

A double-head open-end wrench, with a $2\frac{3}{8}$ -inch opening to remove and install bogie lifting screw shackle pin; and a large $4\frac{1}{4}$ -inch opening for removing and installing bogie trunnion nuts. Also used to remove and install replenisher tube packing housing.

Wrench, face spanner, 60-mm, B168043 (fig. 5)

For removing and installing the counterrecoil cylinder front head. Also used to remove and install counterbalance cylinder rear head.

Wrench, face spanner, 80-mm, BH49A and B (fig. 22)

For removing and installing the replenisher piston guide.

Wrench, oil index follower, A7488 (used with handle A6788) (fig. 5)

For adjusting, removing, and installing the oil index follower in the recuperator rear head.

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



Figure 19—Special Tools—Elevating, Traversing, and Bogie Mechanisms

TOOLS FOR MAINTENANCE AND REPAIR

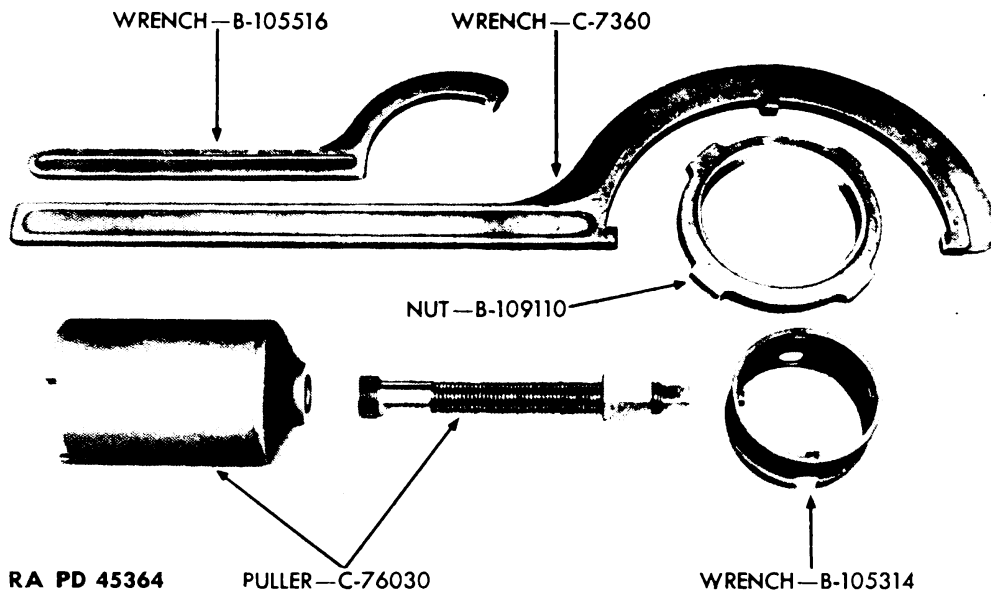


Figure 20—Special Tools—Trunnion Caps and Trail Hinge Pins

Wrench, pintle bolt nut, B158723
(fig. 21)

A special open-end wrench with 3.51-inch opening to hold the pintle bolt nut from turning when adjusting, removing, or installing pintle bolt and nut.

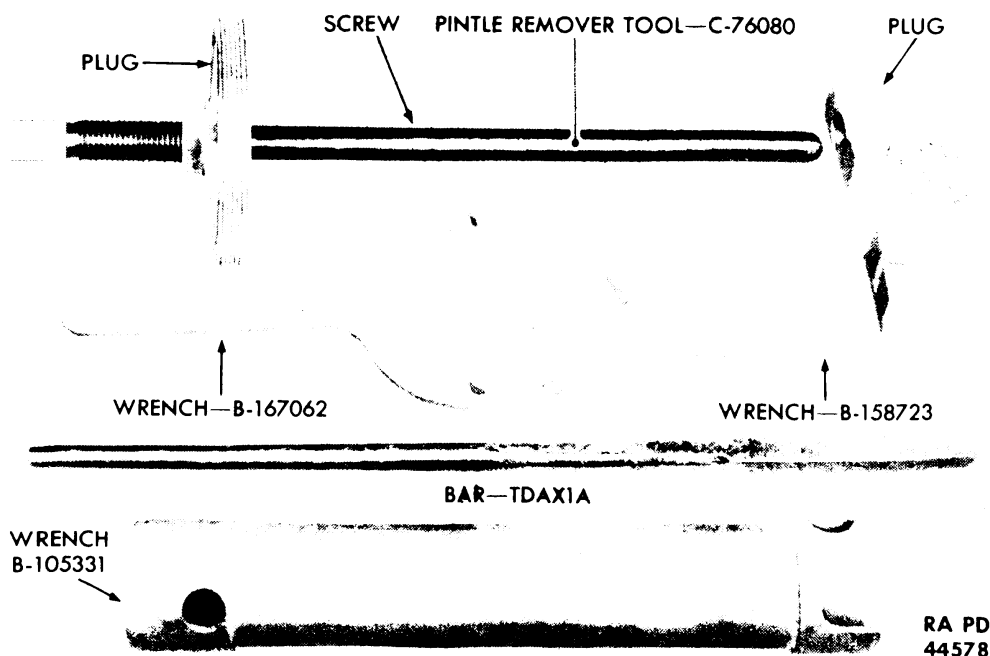


Figure 21—Special Tools—Pintle and Pintle Bolt

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

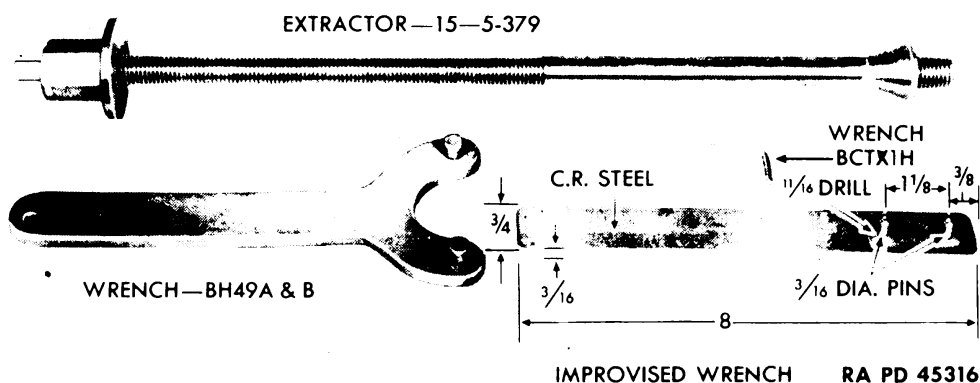


Figure 22—Replenisher Tools

Wrench, socket, B105331 (fig. 21)

For adjusting, removing, or installing the counterrecoil piston rod end nut and or pintle bolt.

Wrench, socket, C68079 (used with handle B108566) (fig. 19)

For adjusting, removing, or installing wheel stud nuts.

Wrench, socket, C69223

Used with socket wrench B105331 when adjusting, removing, or installing the recoil piston rod end nut.

Wrench, socket, elevation intermediate shaft nut, B105327 (fig. 19)

The 4-key type socket wrench used when removing or installing the elevation intermediate shaft nut.

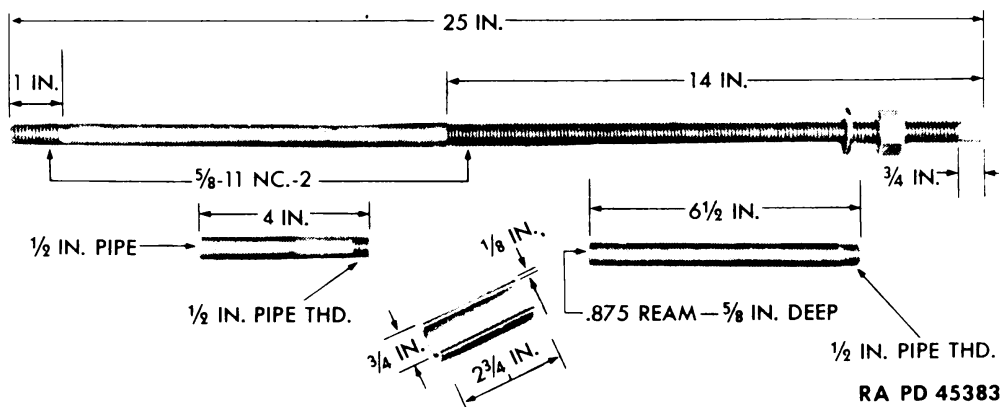


Figure 23—Improved Tools

TOOLS FOR MAINTENANCE AND REPAIR

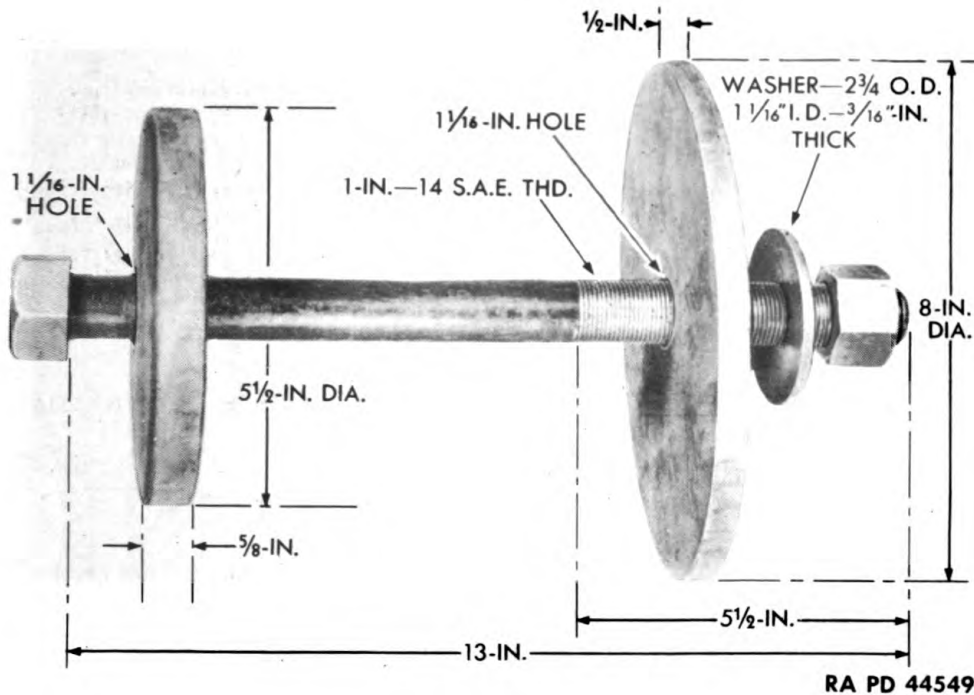


Figure 24—Improved Tools for Installing Pintle Bushing

Wrench, socket, equilibrator stop nut, B105329 (fig. 19)

Wrench, socket, trail pin, B105314 (fig. 20)

Wrench, socket, traversing worm nut, B105313 (fig. 19)

Wrench, socket, traversing worm wheel nut, B105326 (fig. 19)

Wrench, spanner, B167062 (fig. 21)

Wrench, spanner, trunnion bearing nut (3.26-in. radius), B105516 (fig. 20)

Wrench, spanner, trunnion cap (6.52-in. radius), C7360 (fig. 20)

The 4-key type socket wrench used when adjusting, removing, or installing the equilibrator stop nut.

The 4-key type socket wrench used when removing or installing trail hinge pin bottom plugs.

The 4-key type socket wrench used for removing and installing traversing worm nut.

The 4-key type socket wrench used for removing and installing traversing worm wheel nut.

For removing or installing pintle sleeve plug.

For removing and installing trunnion bearing nuts.

For removing and installing trunnion caps.

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TOOLS FOR MAINTENANCE AND REPAIR

Wrench, teat, C73624 (fig. 16)

For disassembling and assembling the Firing Mechanism M1.

24. IMPROVISED TOOLS.

Extractor, counterbalance piston and spring (fig. 23)

Used in disassembly and assembly of counterbalance for repairs or replacements. Quickly and easily made from a $\frac{5}{8}$ -inch diameter cold rolled steel rod, 25 inches long. Flatten end for turning with wrench.

Hook, puller (fig. 25)

To facilitate removal and installation of the large roller bearing upper and lower races and retainer. Make from a piece of $\frac{1}{4}$ -inch diameter cold rolled steel rod about $3\frac{1}{2}$ or 4 inches long fashioned as a hook and threaded for about $\frac{1}{2}$ or $\frac{3}{4}$ inch— $\frac{1}{4}$ inch—20 U. S. STD.

Pipe, recoil cylinder filling (fig. 23)

Used when filling the recoil cylinder with oil, when the recoil mechanism is off the carriage and has been drained. Ream one end of pipe for inserting funnel SFAX1B.

Pipe, recoil cylinder vent (fig. 23)

Used as a vent when filling the recoil cylinder with oil under same conditions as above.

Spacer, counterbalance rod (fig. 23)

Required for removal and installation of the counterbalance assembly. It is placed on the rod, between rod shoulder and counterbalance head, to relieve spring tension. Made from a piece of 1-inch pipe, $2\frac{3}{4}$ inches long with one side cut off so it will fit over rod.

Tool, pintle bushing installation (fig. 24)

Required for installing a new pintle bushing in the bottom carriage.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

Wrenches, recuperator filling and drain valve housing and retainer (fig. 25)

Wrench "B" is used when removing and installing filling and drain valve housing in recuperator head. Wrench "A" is used when removing and installing filling and drain valve retainer in recuperator head.

Section VII

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

	Paragraph
Prepare howitzer (or gun) and carriage for repairs	25
Remove barrel assembly, counterbalance, and breech mechanism	26
Remove equilibrators	27
Disconnect trunnion bearing caps	28
Remove recoil mechanism and trunnion bearing caps	29
Remove top carriage	30
Remove bogie	31
Remove trails	32

25. PREPARE HOWITZER (OR GUN) AND CARRIAGE FOR REPAIRS.

- a. Remove traveling covers, rammer staff sections, spades, and bogie lifting screw ratchet wrenches.
- b. Set the hand brakes on the bogie.
- c. Remove 155-mm gun traveling lock D6268.

NOTE: The 155-mm gun barrel, because of its long overhang, is disconnected from the counterrecoil and recoil piston rods and is carried in the retracted position when traveling. It is held in the retracted position by the traveling lock D6268. The procedure described below for removing the 155-mm traveling lock calls for two overhead traveling cranes of 5-ton capacity each. It is also satisfactory to use the single crane on the Heavy Wrecking Truck M1, taking care to position the crane lift hook approximately at the center of gravity of the gun barrel.

(1) Disconnect the gun barrel from the traveling lock D6268 by releasing locking pin B108153.

(2) Place one cable sling around the breech ring (breechblock open) and the other around the barrel just ahead of the trunnion caps. Be sure to wrap clean cloths around cable slings where they contact barrel. By means of the overhead traveling cranes, lift up on the cable slings until weight of barrel is just off the gun rails and cradle slides, and thoroughly lubricate slides and rails.

(3) Slide the gun into battery by means of the prime mover and the retracting cable C73730, which is attached to the hook under the breech ring and passes over and around the sheave and over the top of the breech ring (breechblock open).

(4) Secure the gun barrel in battery with counterrecoil and recoil piston rod nuts A19824 and A22326 and cotter pins BFAX2BD and BFAX2CR (figs. 11 and 12). **NOTE:** It is necessary to allow a slight floating of the piston rods in the gun lug to prevent excessive wear

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

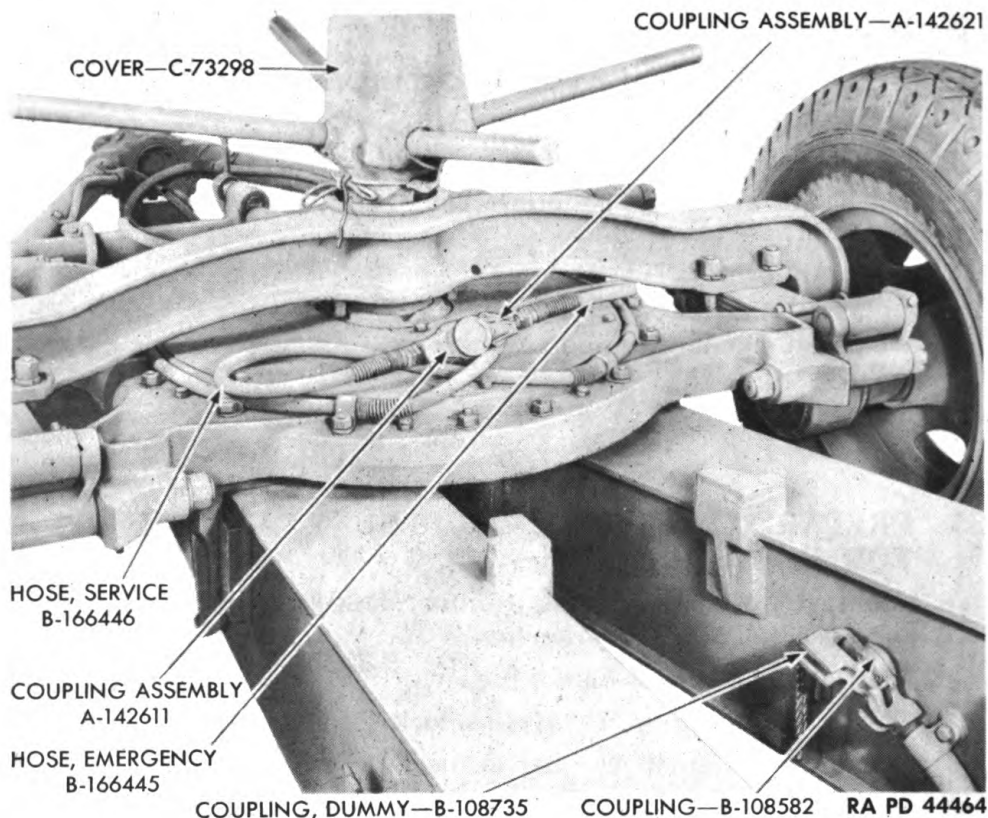


Figure 26—Limber Hoses—Disconnected

on the stuffing boxes due to slight irregularity in alinement of the recoil mechanism. Draw nuts tight; then back them off enough to allow approximately 0.005-inch end play between gun lug and recoil and counterrecoil piston rod yoke.

(5) Remove cotter pin from traveling lock clevis pin where clevis is attached to bottom carriage. Tap out clevis pin and disconnect clevis. Remove key pins from two keys B106164 and tap key out of traveling lock D6268.

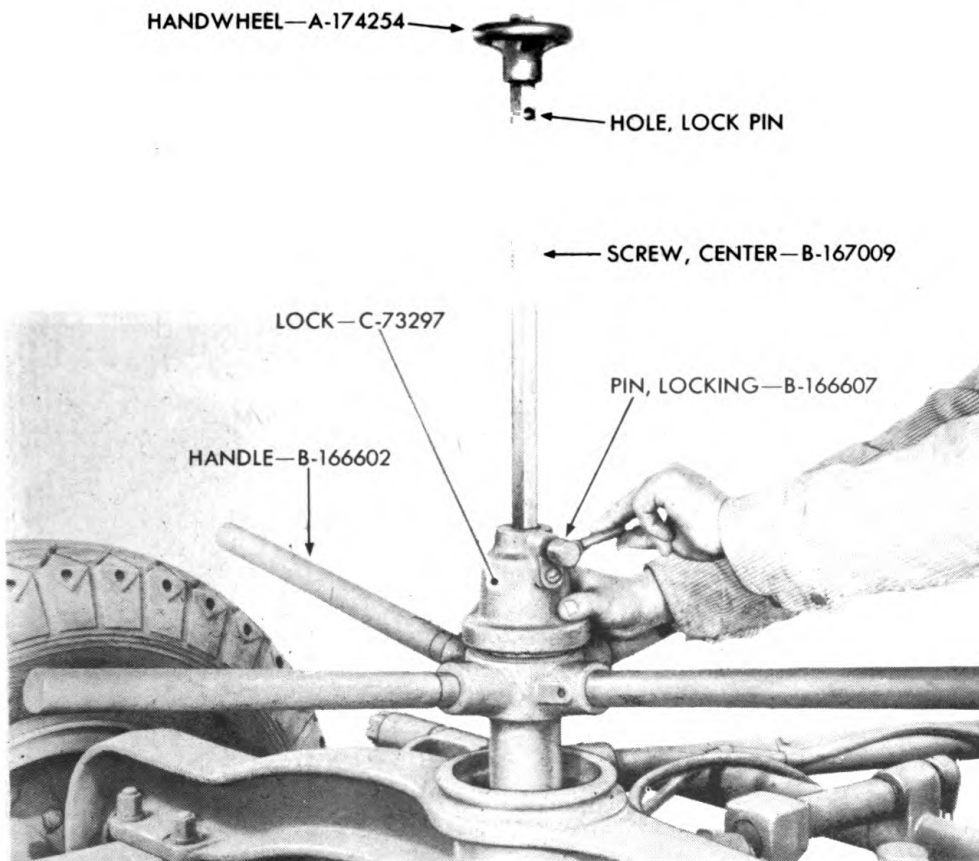
(6) Lift traveling lock and cable from trails.

d. Remove Heavy Carriage Limber M2.

NOTE: The limber illustrated has the type A limber lifting mechanism assembly. (List of all parts, SNL D-29, dated 22 May 1943, and SNL D-24, dated 12 June 1943.)

(1) Place a heavy timber under trails just below air coupling. Remove cover C73298 from limber lifting mechanism (fig. 26).

(2) Disconnect limber air hose coupling assemblies A142611 and A142621 from couplings B108582 on trails. Place dummy couplings B108735 in position on couplings B108582 to prevent dust or dirt from

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

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Figure 27—Unlocking Limber Lifting Mechanism

entering air hoses and to avoid malfunction of brake mechanism. Lock limber air hose coupling assemblies A142611 and A142621 together. Check to see that couplings at rear of limber were locked together when limber was disconnected from prime mover.

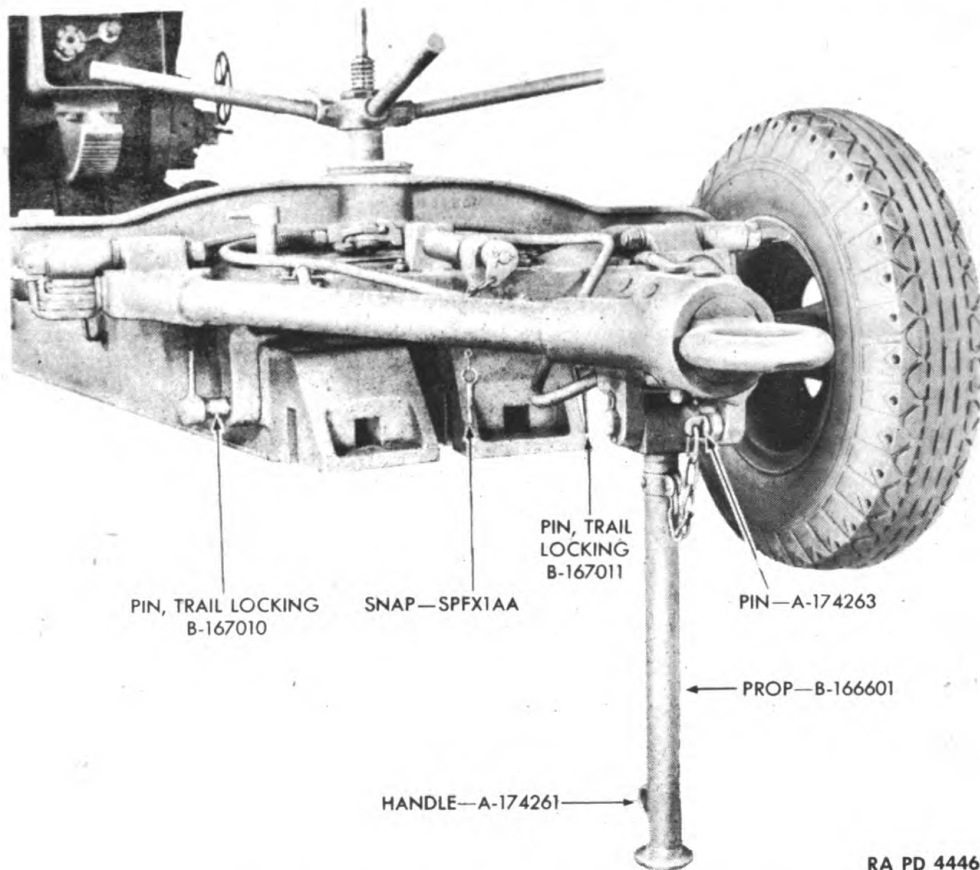
(3) Turn locking pin B166607 to release limber lifting mechanism lock C73297. Slide lock up on center screw B167009 and secure it by placing locking pin in hole provided at top of center screw (fig. 27).

(4) To unlock limber for removal from trails, turn the handles of the trail locking pins B167010 and B167011 up, pull out on handles, and turn handles down. (In figure 28, one handle is shown up and the other down.)

(5) Make sure that drawbar locking pin B166610 is in locked position in the lifting mechanism tube B166604 (fig. 322). It should have been placed there when materiel was disconnected from the prime mover. Remove pin A174263 and swing prop B166601 up under drawbar. Secure by placing snap SPFX1AA in handle A174261.

(6) Turn the limber lifting mechanism handle B166602 and lower the trails until they rest on the wood timber. Continue to turn the

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



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Figure 28—Limber Unlocked for Removal

handle until trail base guide arms are free of the guides in the trails; then remove limber.

e. Spread Trails. Using a crane and heavy cable sling, lift the left trail and swing it out. Place the left trail on wood timber. Do the same with the right trail.

26. REMOVE BARREL ASSEMBLY, COUNTERBALANCE, AND BREECH MECHANISM.

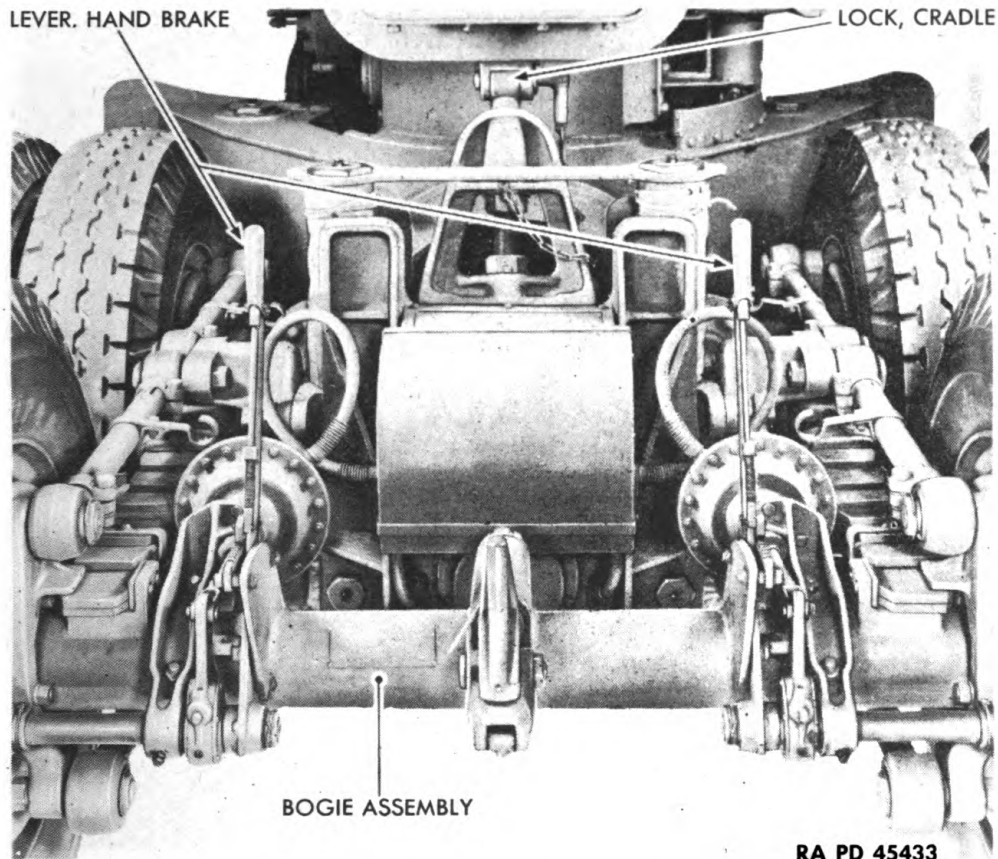
a. General. The operations for the removal of the barrel assembly are the same for removing either the 155-mm gun barrel or the 8-inch howitzer barrel.

b. Procedure.

(1) Be sure that the barrel is in a level position.

(2) Be sure that the cradle lock is in the locked position and that the bogie hand brakes are set (fig. 29). **CAUTION:** Never attempt to remove a barrel with the cradle lock in the unlocked position and the equilibrators attached to the cradle and top carriage. The equi-

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE



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Figure 29—Cradle Lock in Locked Position

brators will cause the cradle to fly up into fully elevated position as soon as barrel weight is removed, causing serious damage and possible injury.

(3) **REMOVE QUADRANT MOUNT M1.**

(a) Loosen and remove the screws and washers which attach Quadrant Mount M1—90-66 to pin B155837 (fig. 30).

(b) Pry the mount away gently with a screwdriver. The two dowel pins will either come away with mount or remain in trunnion pin.

(4) **REMOVE TELESCOPE MOUNT M18A1—90-65.**

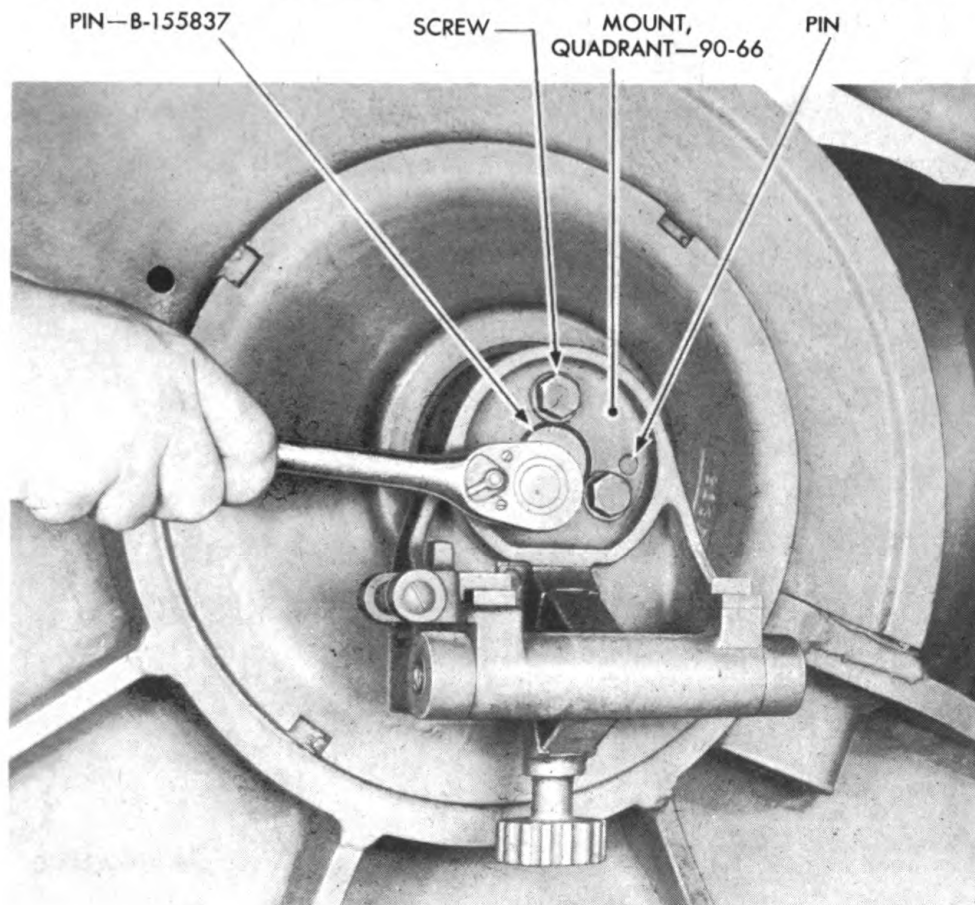
(a) Remove four screws and washers from mount bracket C91610.

(b) Pry the Mount M18A1—90-65 away gently (fig. 31). The dowel pin will either come away with mount bracket or remain in trunnion cap.

(5) **REMOVE REBOUND LINERS AND SEAL AND HOLD-DOWN CLIP.**

NOTE: When it is known that the gun (or howitzer) and carriage are to be completely disassembled, it is advisable to remove liners (fig. 32) before removing the barrel or cradle. The weight of the bar-

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



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Figure 30—Removing Quadrant Mount Retaining Screws

rel and cradle; when mounted, makes it much easier to remove these liners.

(a) Traverse materiel to left as far as it will go. Remove eight screws A171875 and washers BECX1K from seal C69025 (fig. 33). Slide seal out. Be careful not to damage seal when removing. Remove liners C73060 and C73061 by traversing materiel right and left. Liners are located between top and bottom carriages under seal.

(b) Remove two screws BCBX2CF, one screw BCBX2CC, and three washers BECX2R, and remove clip C76167 (fig. 34).

(6) REMOVE COUNTERRECOIL AND RECOIL PISTON ROD END NUTS. Remove cotter pins BFAX2BD and BFAX2CR from nuts A19824 and A22326 and remove nuts (figs. 11 and 12).

(7) REMOVE FIRING MECHANISM ASSEMBLY M1.

(8) REMOVE BARREL.

CAUTION: Extreme care must be used in removing barrels. The gun barrel weighs 9,595 pounds and the howitzer barrel 10,240 pounds.

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

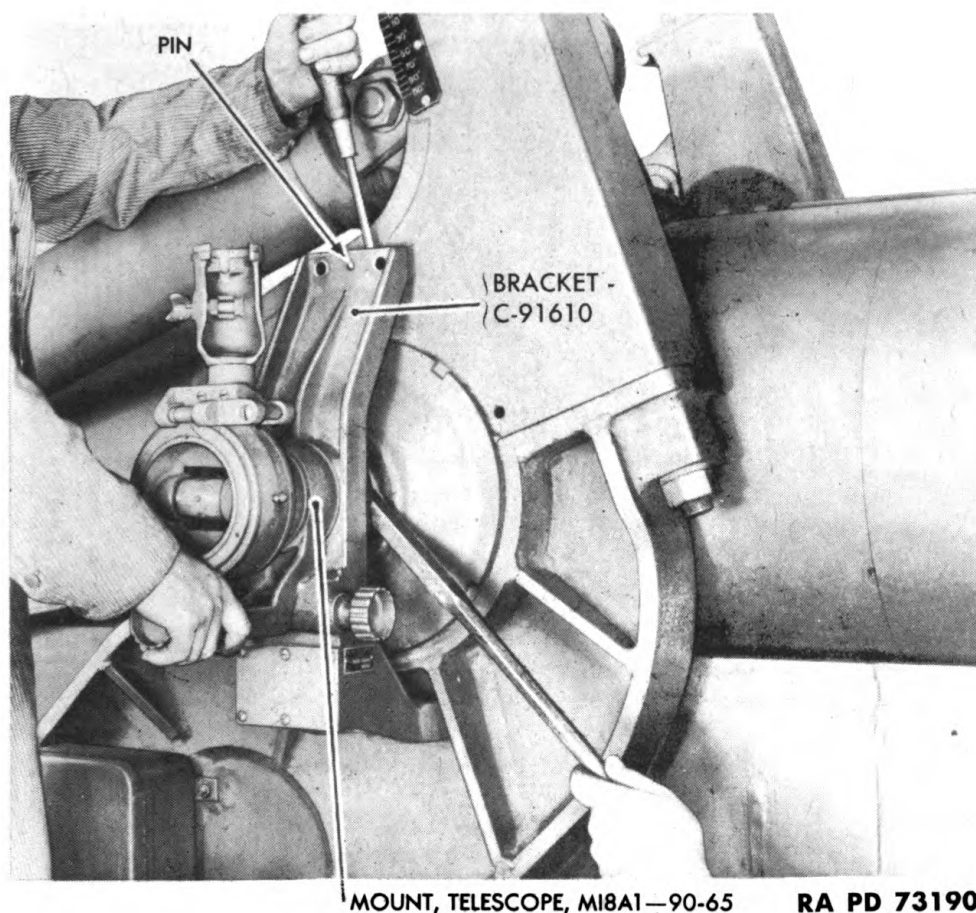


Figure 31—Removing Telescope Mount

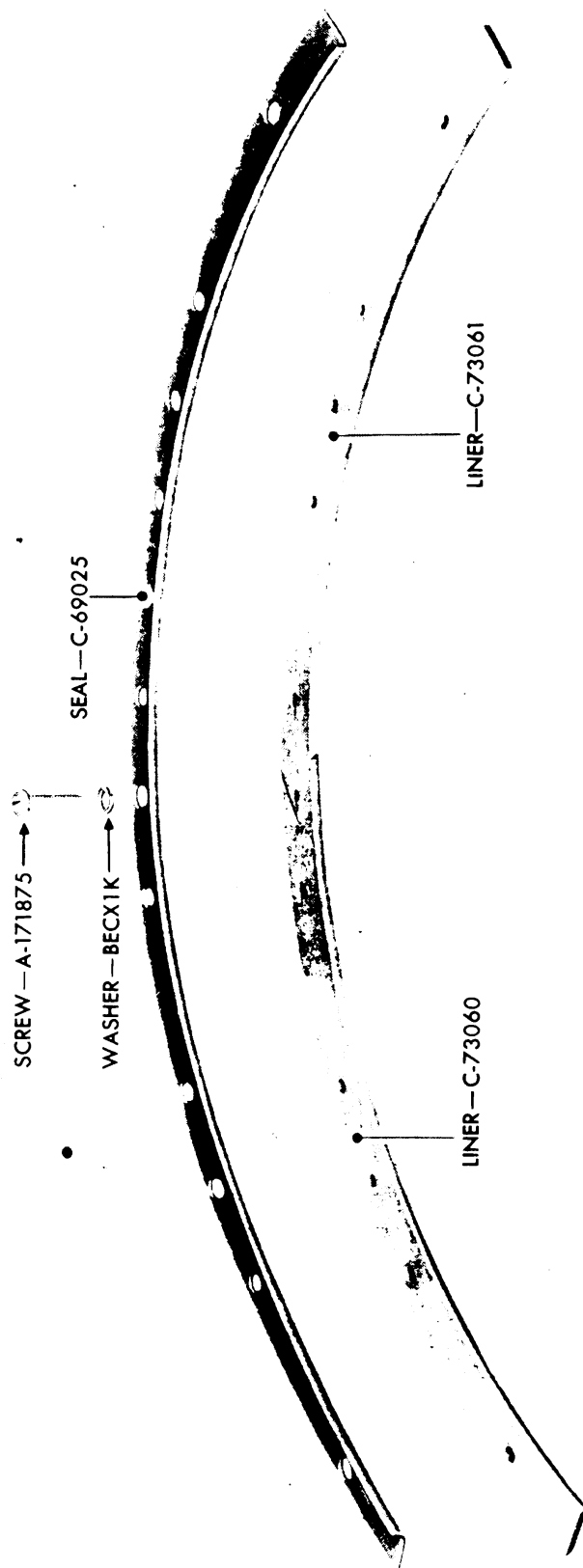
Make certain that all equipment used in removal operations is substantial enough to carry these loads.

(a) Open breech by pressing down on breechblock operating lever catch. Then pull the operating lever to the rear and downward to the limit of its travel. Now swing the operating lever around to the right until the carrier stops against the breech ring.

(b) Place a wire cable around the breechblock carrier lug of the breech ring. Be sure to place clean cloth between and around cable where it contacts the breech ring. Attach the cable to prime mover and pull barrel to rear about 5 or 6 inches (fig. 35). NOTE: If the barrel of the 155-mm gun is being removed, use retracting cable C73730.

(c) Place a heavy cable sling, wrapped in clean cloth, around the breech ring. Hook a crane to cable sling and lift weight of barrel off the barrel rails and cradle slides (fig. 36). Pull barrel to rear with prime mover and cable until only 8 inches of the barrel rails are in the cradle slides.

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



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Figure 32—Bottom Carriage Liners and Seal

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

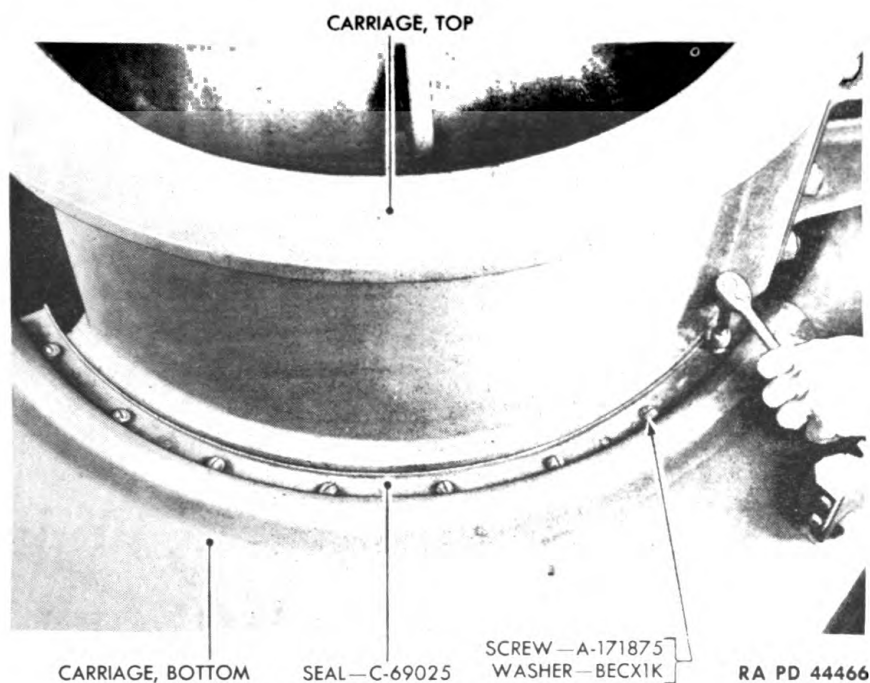


Figure 33—Removing Seal Screws

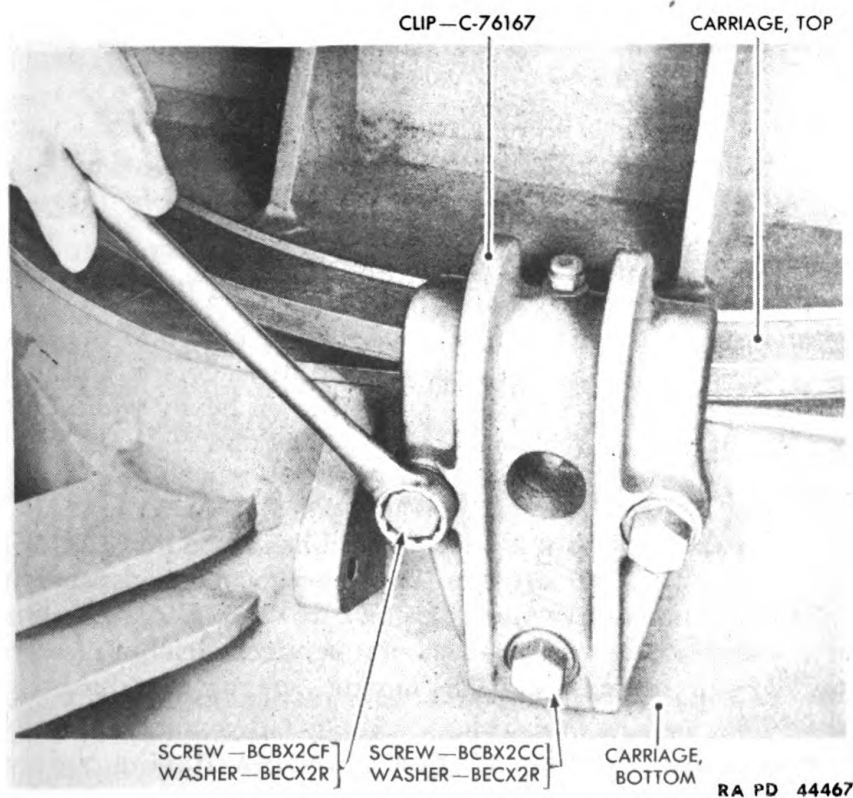


Figure 34—Removing Top Carriage Rear Hold-down Clip

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

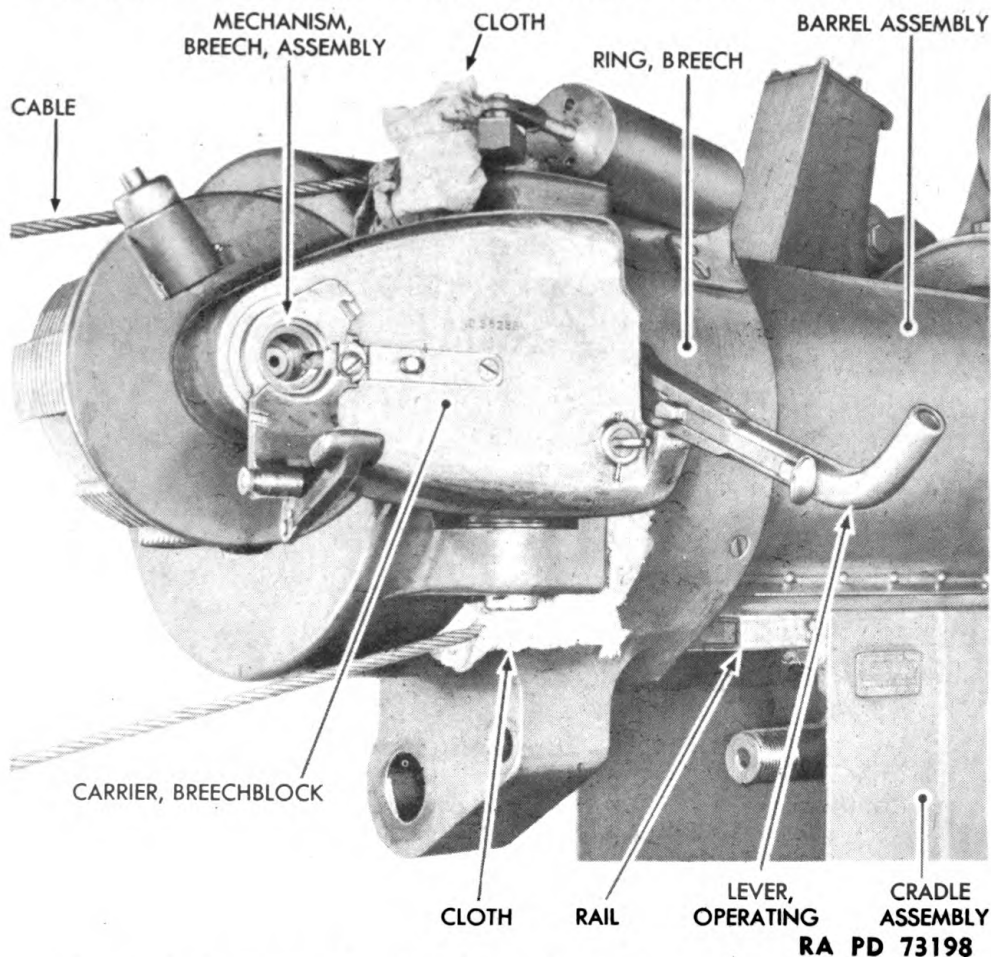


Figure 35—Removing Howitzer Barrel Assembly (Step A)

(d) Remove the cable and prime mover.

(e) Place another heavy cable sling, wrapped in clean cloth, around the barrel just back of the top carriage (fig. 37). Slide the barrel to the rear until muzzle end will clear the top carriage and cradle. Move the barrel away from the carriage and place on heavy wood blocks or horses (figs. 38 and 39). Remove cable slings and cloth.

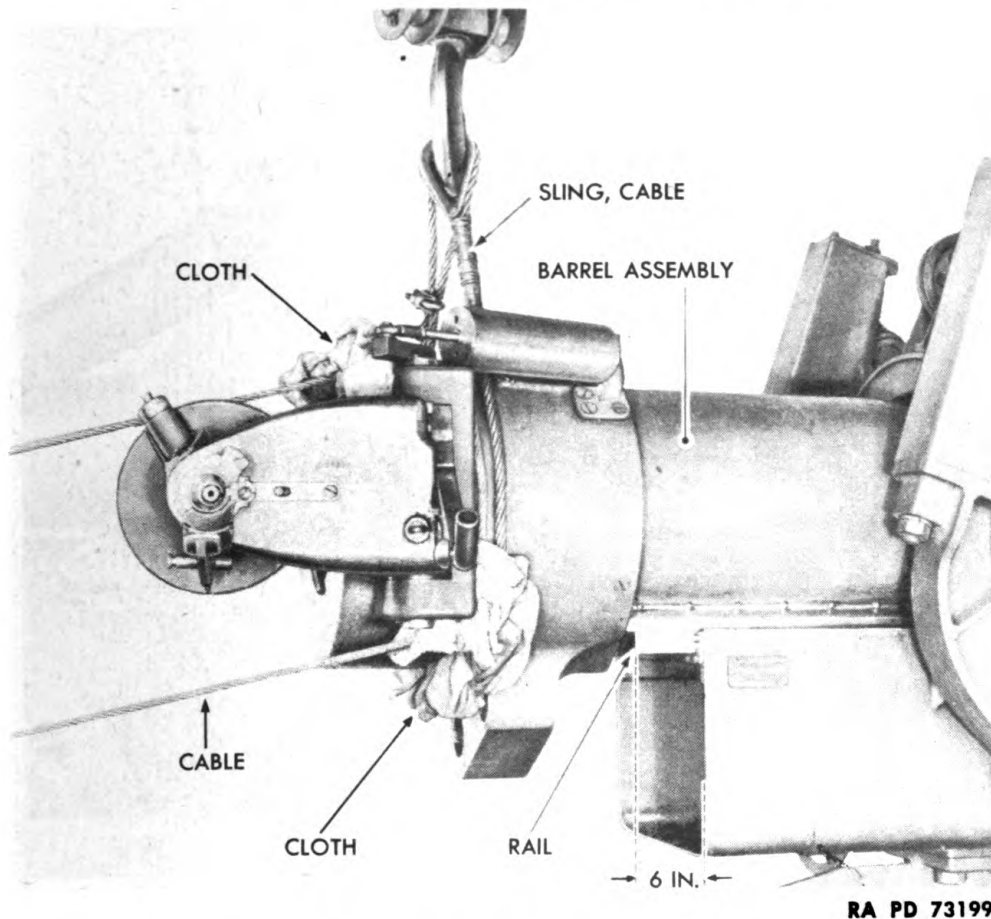
27. REMOVE EQUILIBRATORS.

a. **General.** The equilibrator assemblies used on the 155-mm gun and 8-inch howitzer are similar in design and construction (fig. 40). Two methods are given below for removing equilibrators. Method 1 is used for carriages having serviceable equilibrators and Method 2 is used for carriages having one or two unserviceable equilibrators.

b. **Procedure: Method 1 (For Carriages Having Serviceable Equilibrators).**

(1) With the gun (or howitzer) in the in-battery position, elevate

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE



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Figure 36—Removing Howitzer Barrel Assembly (Step B)

to maximum and remove lower plug A19611 from each rear equilibrator head. Insert adapter plug A235062 and tighten sufficiently to prevent oil leakage, being sure the tapped hole in the plug lies approximately parallel to, or slightly below, the equilibrator pins and pointing away from the barrel. Depress the gun (or howitzer) and lock cradle traveling lock.

(2) Assemble the remainder of the adapter B291711 (fig. 17) to the equilibrator to be removed. Connect the copper tube and connection C76901 between adapter B291711 and Oil Pump M3. If flexible hose B221731 is to be used instead of copper tube, remove the connector A338490 from the adapter assembly B291711 and insert the hose connection directly into adapter valve A338492.

(3) After all connections are made, fill Oil Pump M3 with recoil oil and pump into equilibrator until oil begins to leak around the equilibrator head and copper tube or hose connection. This leakage will indicate that a sufficient quantity of oil has been introduced to relieve the tension on the equilibrator pins, thus obtaining the desired

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

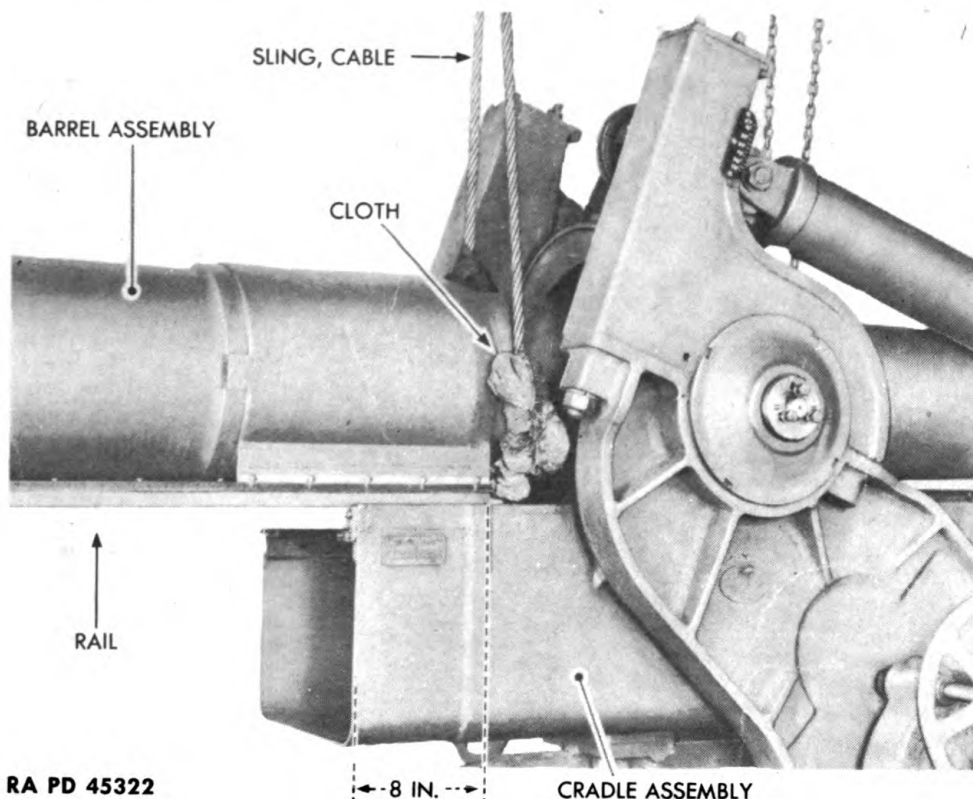


Figure 37—Removing Howitzer Barrel Assembly (Step C)

disassembly position. The effort required to operate the oil pump will be noticeably increased.

CAUTION: Approximately 2 gallons of oil will be necessary, and care should be taken to see that the oil pump does not run dry during the operation.

(4) Remove nut BBDX3B and washer BECX2W from equilibrator connecting shaft B105203. Place a bar or length of timber (2 x 4) between trunnion cap and equilibrator cylinder.

(5) Open the valve on the oil pump and allow enough time for the pressure on the oil to subside; then close the oil pump valve and start pumping again.

(6) Tap the shaft B105203 with a copper hammer and continue pumping until there is no longer tension on connecting shaft B105203 and remove shaft. Close adapter valve A338492 and disconnect oil line.

(7) Remove cotter pin BFAX2CE, nut BBEX2E, and washer A19590 which secure the front end of the equilibrator to the cradle.

(8) Lift equilibrator from gun or howitzer (three men or cable and crane).

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

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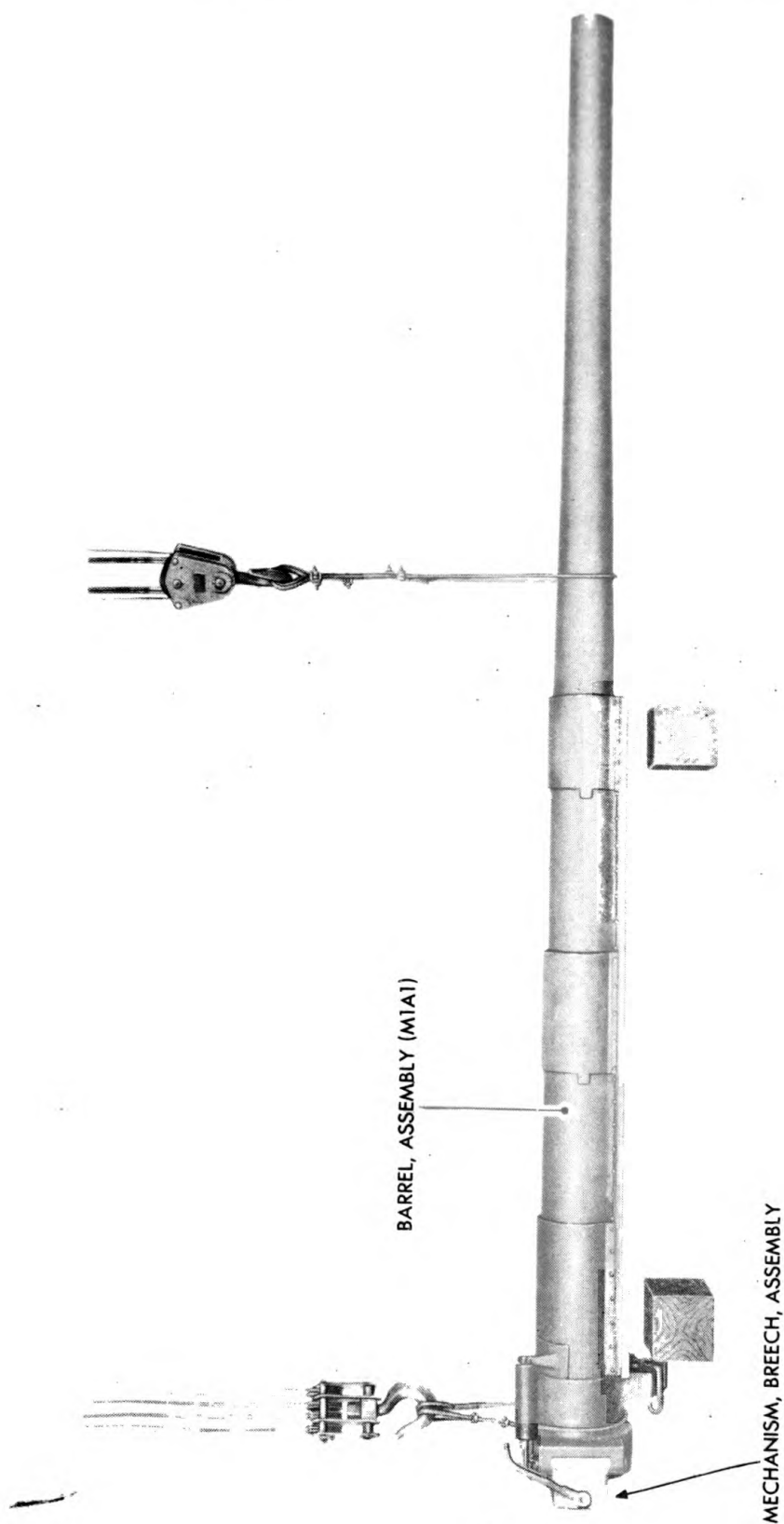
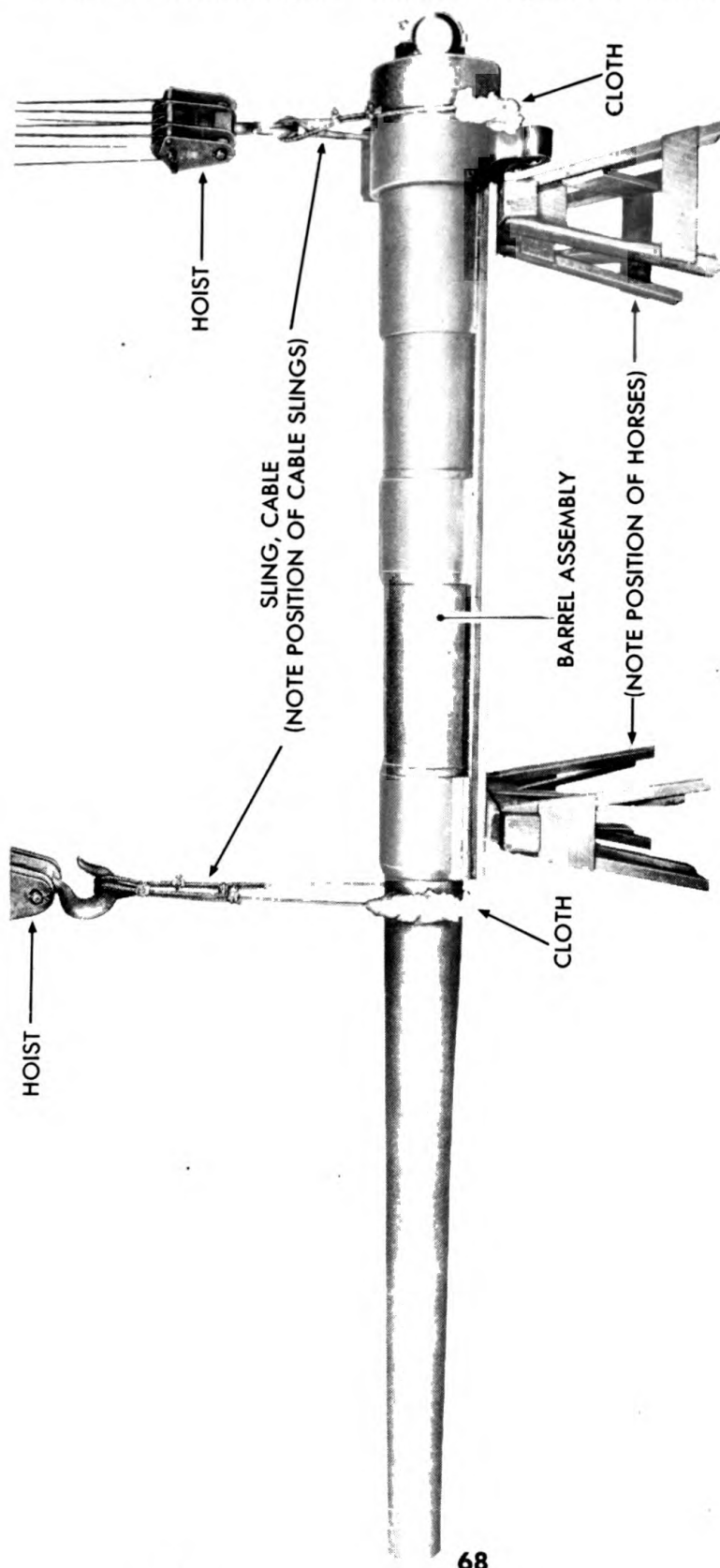


Figure 38—155-mm Gun Barrel Assembly

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 45361

Figure 39—8-Inch Howitzer Barrel Assembly

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

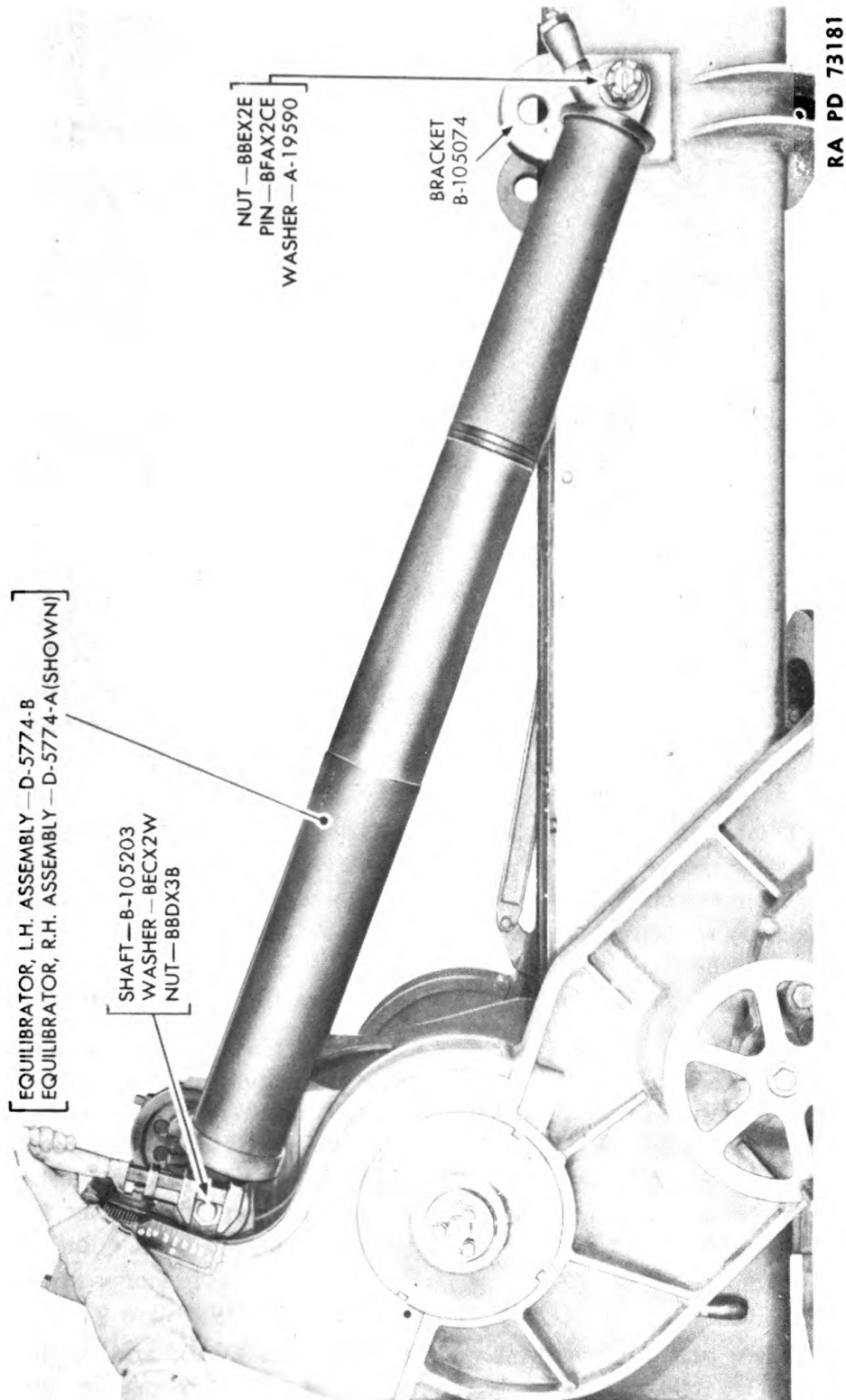
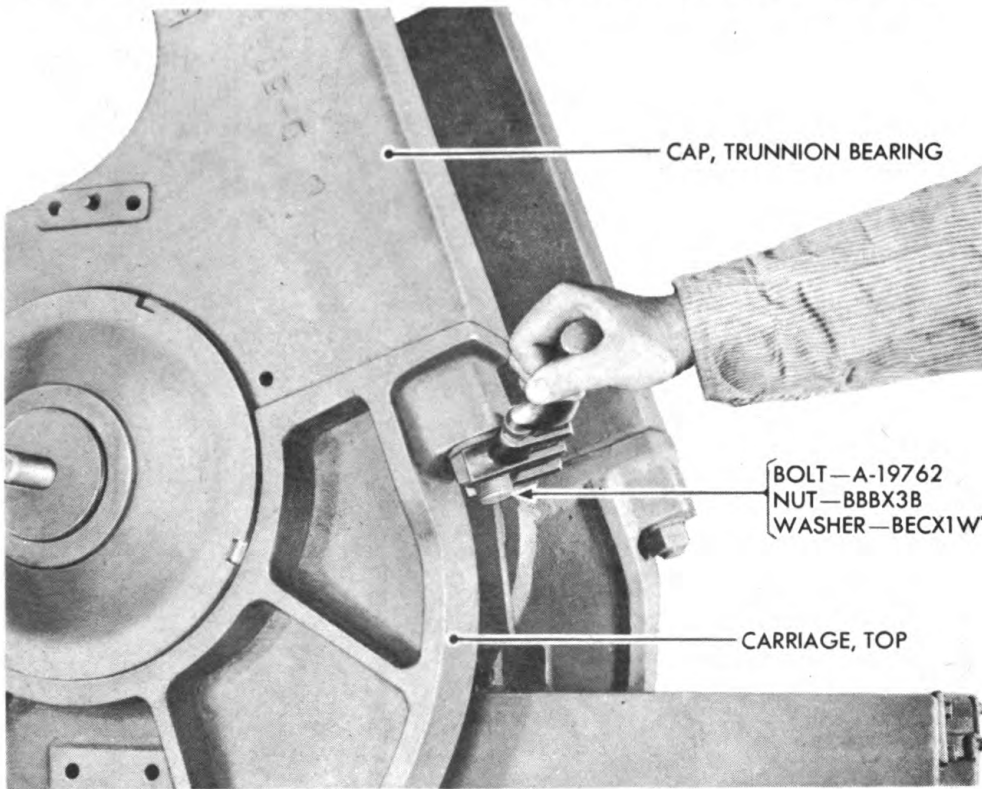


Figure 40—Removing Equilibrator Assembly

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 44450

Figure 41—Removing Trunnion Cap Rear Bolts

CAUTION: Do not disturb the adapter when removing the equilibrator.

(9) Drain the oil from the equilibrator which has just been removed and disconnect adapter assembly B291711 so that it may be used to remove the other equilibrator.

(10) Proceed in the same manner to remove the other equilibrator.

c. Procedure: Method 2 (For Carriages Having One or Two Unserviceable Equilibrators). Remove the elevating stop. If any nitrogen remains in the unserviceable equilibrator (or equilibrators), it should be drained off. The equilibrator (or equilibrators) can then be removed from the carriage by removing the nut BBDX3B, washer BECX2W, and shaft B105203 at the rear end and the cotter pin BFAX2CE, nut BBEX2E, and washer A19590 at the front end.

28. DISCONNECT TRUNNION BEARING CAPS.

a. Loosen and remove bolt A19762, nut BBBX3B, and washer BECX1W from left trunnion bearing cap and top carriage (fig. 41). Loosen and remove bolt A19883 and washer BECX1W (fig. 42).

b. Repeat subparagraph a above on the right trunnion bearing cap.

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

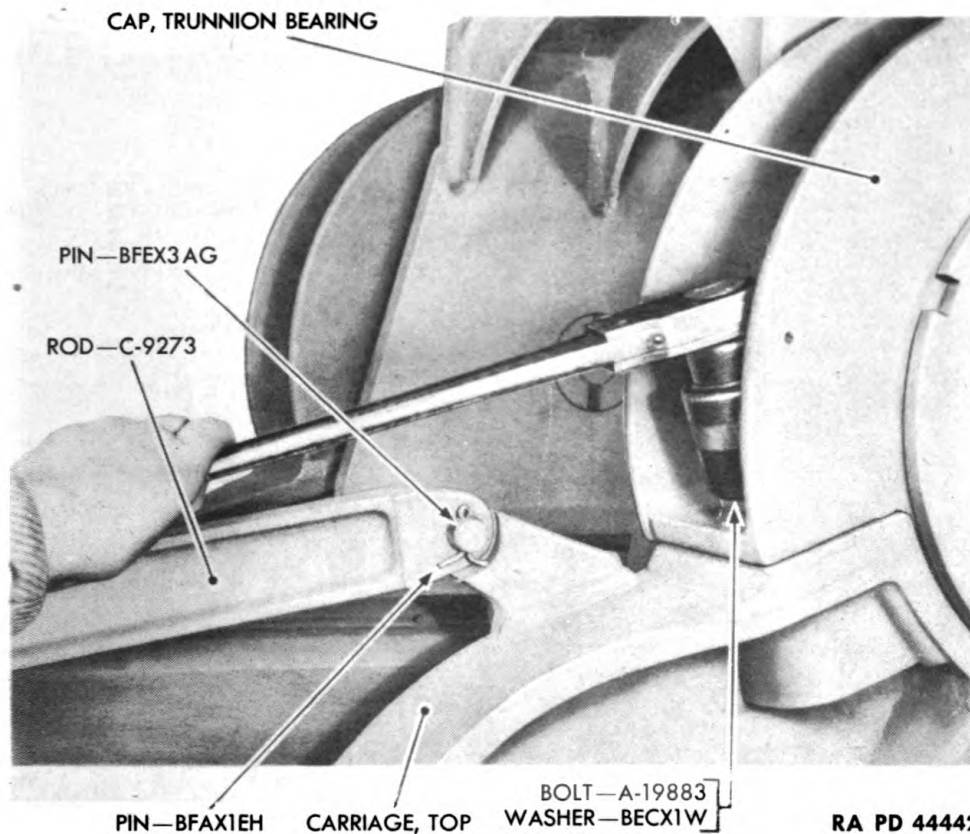


Figure 42—Removing Trunnion Cap Front Bolts

c. The trunnion bearing cap assemblies are now loosened and will come away when the recoil mechanism is removed (par. 29).

29. REMOVE RECOIL MECHANISM AND TRUNNION BEARING CAPS.

a. Remove cotter pins BFA1EH from pin BFEX3AG, and tap straight pin out of rod C9273 (fig. 42).

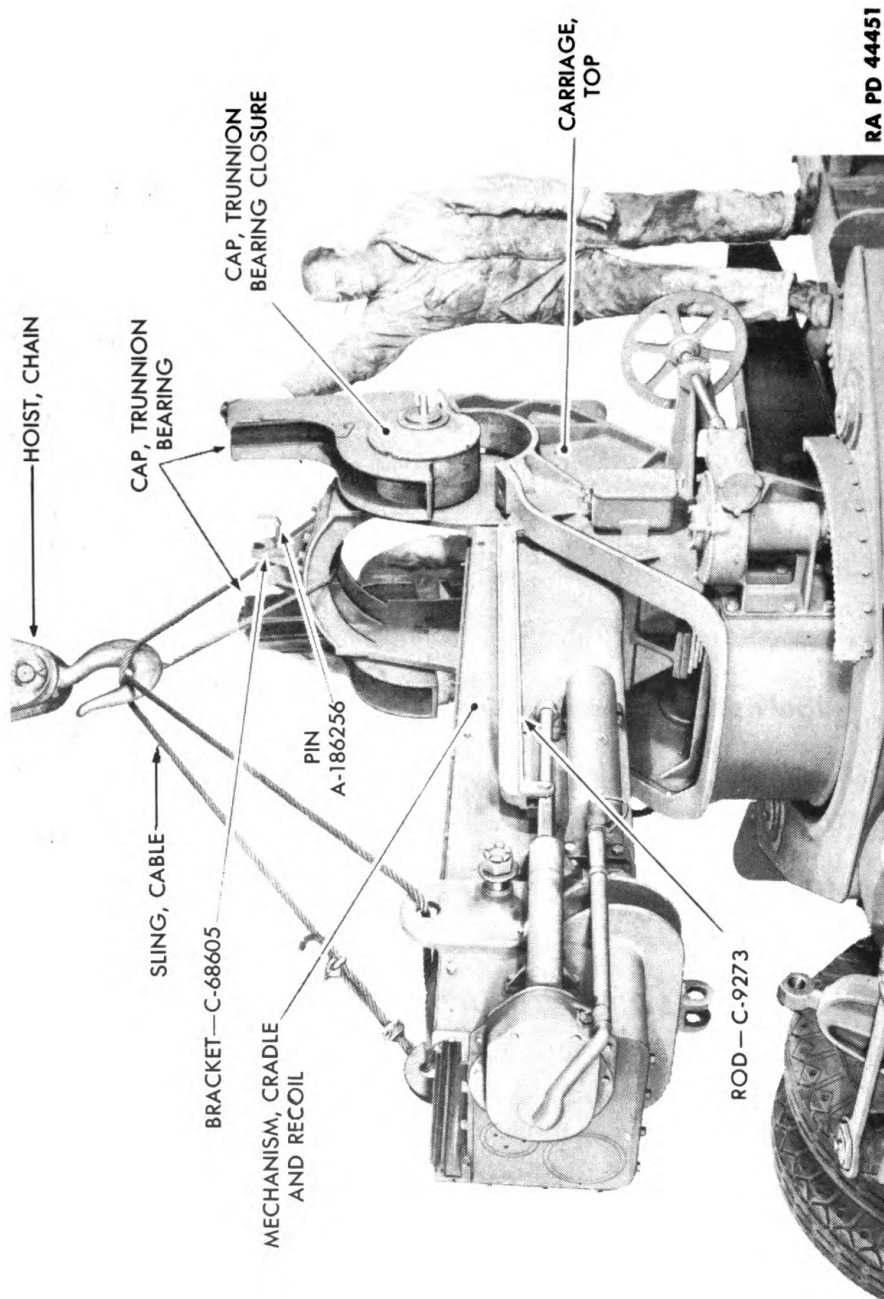
b. Remove sheave and bearing from bracket C68605 by pulling out on pin A186256 (fig. 43).

c. Unlock cradle lock by unfastening snap SPFX1AA and turning and pulling out cradle lock pin B170996 (fig. 44).

d. String a 1-inch diameter cable through the equilibrator bracket eyes and around sheave bracket at rear of cradle. Cross the cable in the center where it fits over the crane hook (fig. 43). Fasten the cable securely with two 1-inch cable clamps.

e. Place cable sling over the crane hook and lift slowly. Make certain that weight is equalized and recoil mechanism is lifted evenly front, rear, and sideways.

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 44451

Figure 43—Removing Recoil Mechanism

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

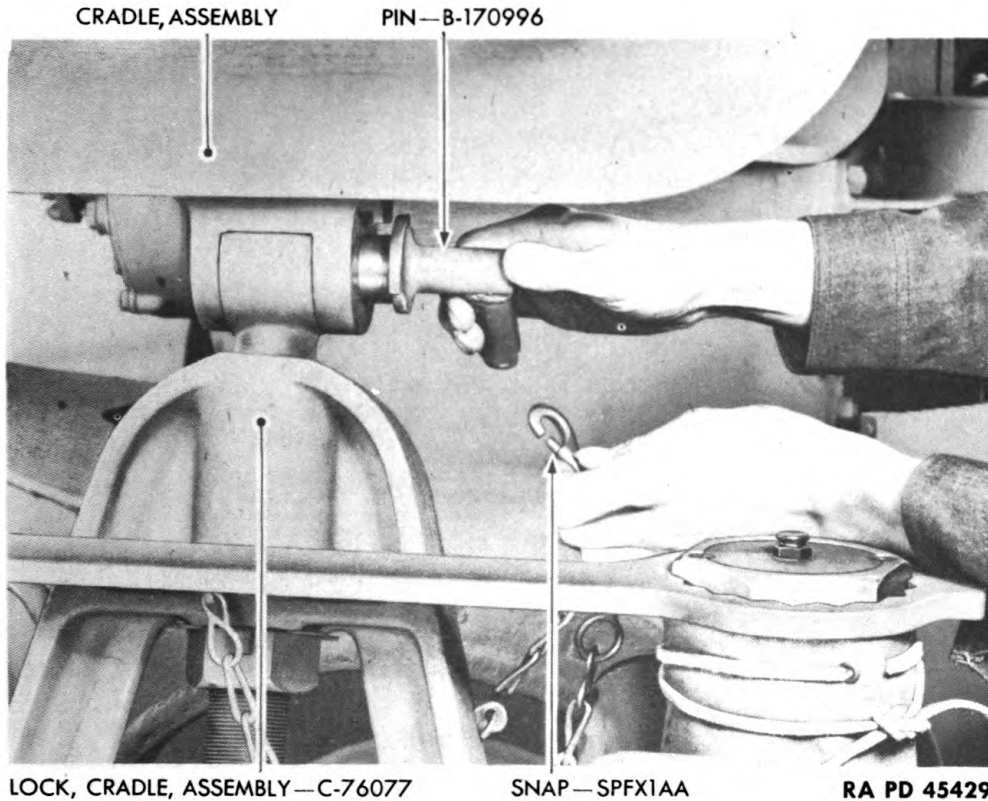


Figure 44—Unlocking Cradle Lock

f. Lift recoil mechanism up and away from carriage. Cradle trunnion bearing cap assemblies must be supported while the recoil mechanism is removed, otherwise, they will swing down and may be damaged. Two men are required to hold the cradle trunnion bearing caps. Place recoil mechanism on two heavy wooden horses. Remove cable sling.

NOTE: The trunnion bearing cap assemblies are removed and disassembled as described in paragraph 47.

30. REMOVE TOP CARRIAGE.

NOTE: The bottom carriage seal, two bottom carriage rebound liners, and the top carriage rear hold-down clip were removed before the barrel and recoil mechanism assemblies were removed (par. 26).

a. Remove four screws BCAX1AA and washers BEAX1H from pintle bolt cover B158579 (fig. 45). Lift cover off.

b. Remove cotter pin BFAX2CP from pintle bolt C68849 and nut A171886 (fig. 46).

c. Remove bottom carriage pintle bearing plug B158125 from bottom of bottom carriage with spanner wrench B167062.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

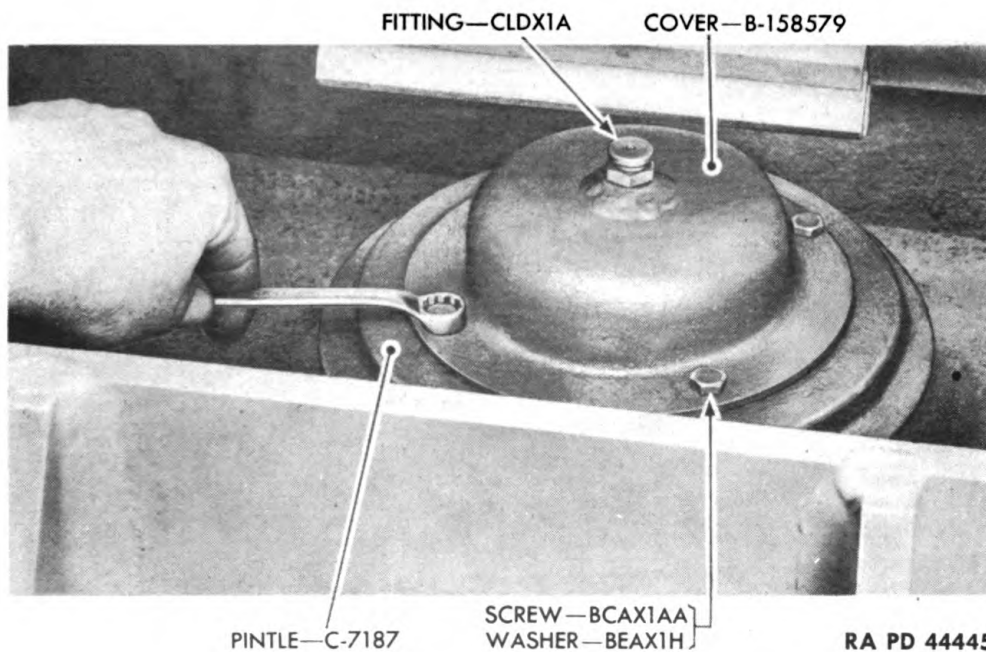


Figure 45—Removing Pintle Bolt Cover

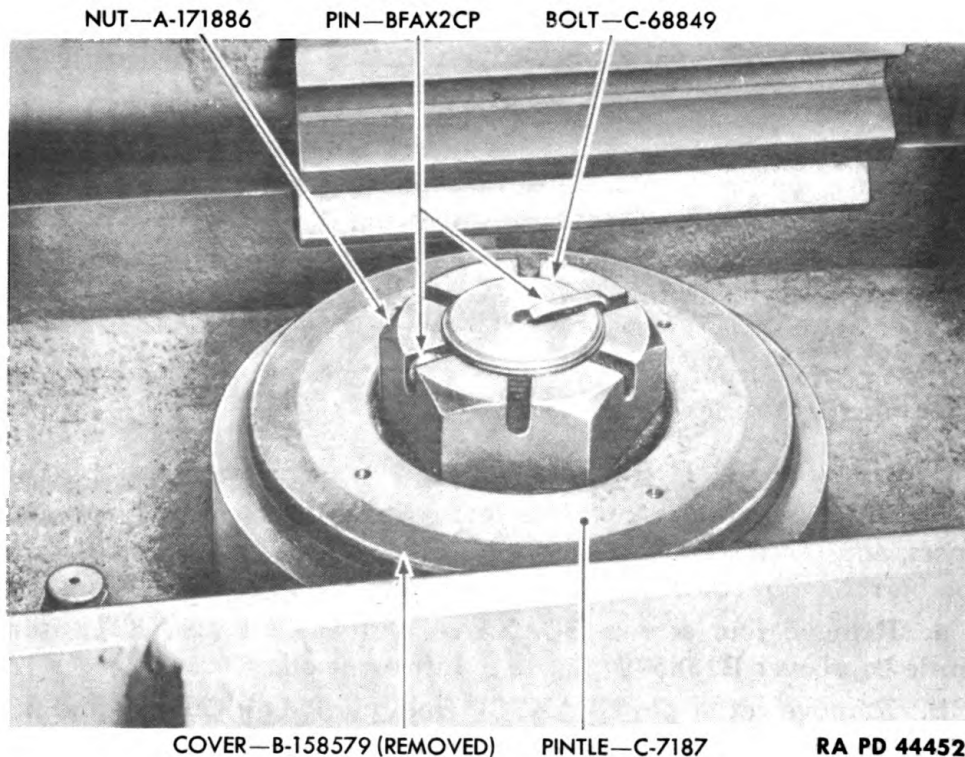
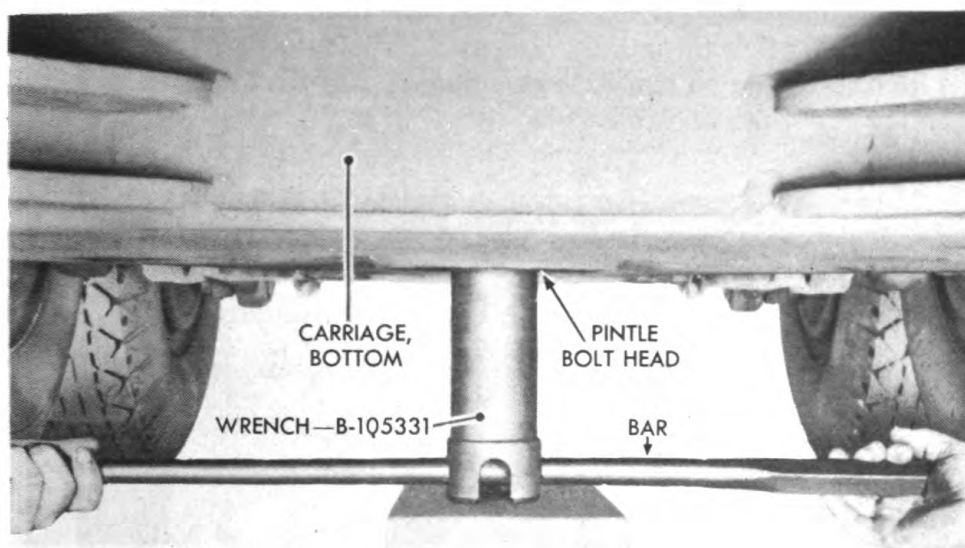


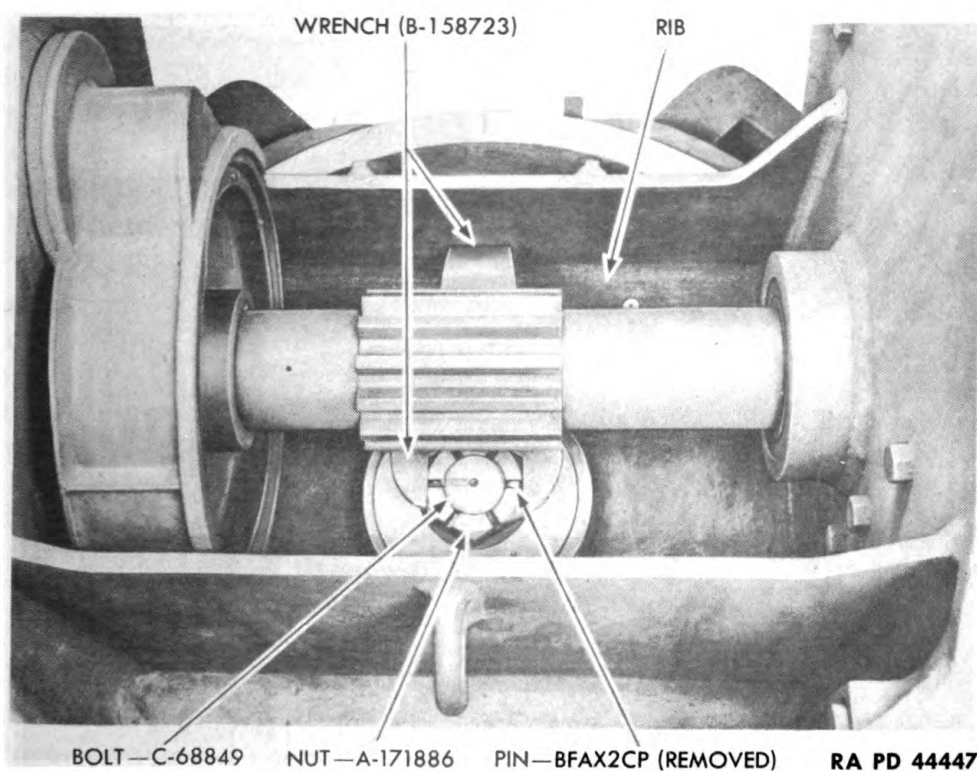
Figure 46—Pintle Bolt and Nut

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE



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Figure 47—Removing Pintle Bolt



RA PD 44447

Figure 48—Holding Pintle Bolt Nut

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

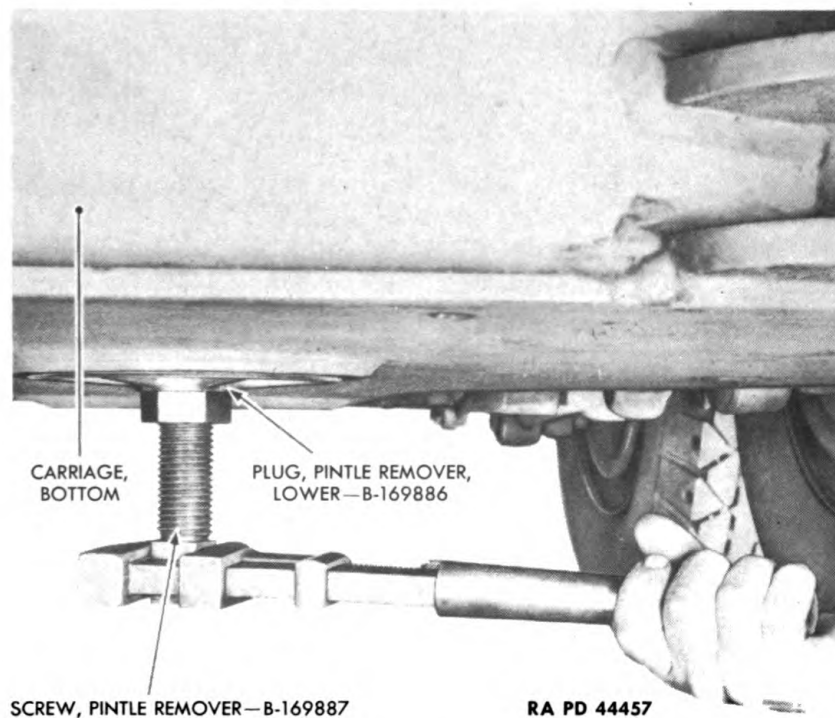


Figure 49—Removing Pintle from Bottom Carriage

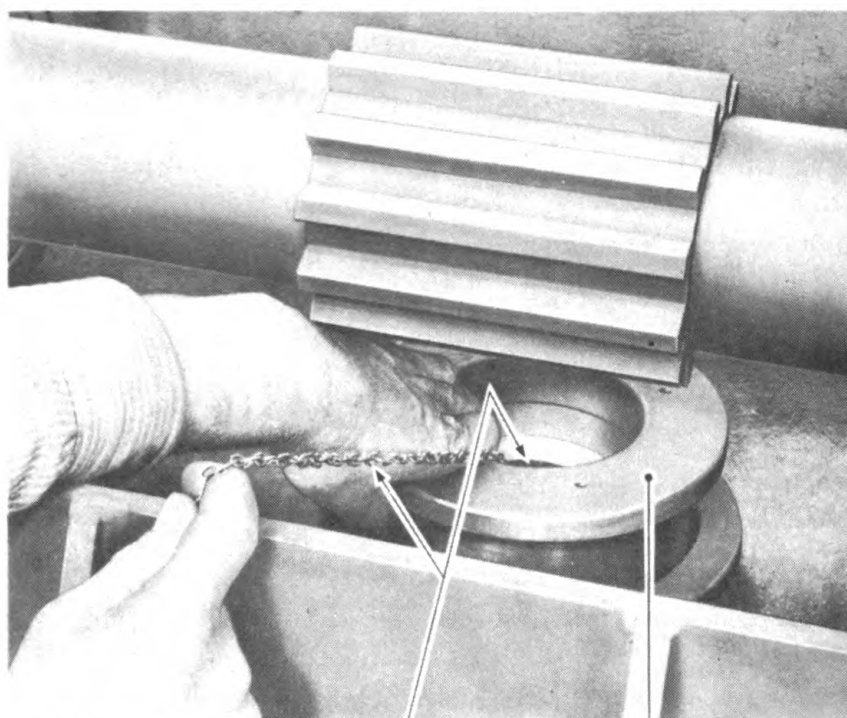


Figure 50—Placing Pintle Remover Upper Plug in Position

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

d. Place special socket wrench B105331 in position on pintle bolt head and block up wrench with wood block 4½ inches high (fig. 47). Using a round steel pinch bar, turn wrench and pintle bolt and nut so that special pintle bolt nut wrench B158723 can be placed around the pintle bolt nut with the slot in the wrench on the rib in the top carriage (fig. 48).

e. Turn pintle bolt C68849 out of nut A171886 and remove both.

f. Reach inside of pintle from top and remove roller bearing A171739. This bearing will come out in three parts; top race, roller section, and bottom race. Top and bottom races are interchangeable.

g. Screw the pintle remover lower plug B169886 on pintle remover screw B169887 (fig. 21). Make certain the hexagonal part of lower plug is toward the nut end of screw. Insert the pintle remover plug and screw in place in bottom carriage by screwing plug in bottom carriage plug opening (fig. 49).

h. Insert the pintle remover upper plug A189897 (fig. 21) in position in pintle. Insert from top of pintle, reach in, and position plug. Hold plug in position with chain (fig. 50). Run screw of pintle remover up into cupped portion of upper plug.

i. Screw up on pintle remover screw and force pintle C7187 up out of pintle sleeve in bottom carriage.

j. Place a heavy cable sling around the hook in the front inside of top carriage, and another around the rear top of the top carriage (fig. 51). Place the rear trunnion bearing cap bolts A19762 (fig. 41) back in holes in top carriage to keep cable sling from slipping off. Using a crane with lifting capacity of 2,000 pounds, lift top carriage up and back so that the top carriage bearing will clear the protruding lip on the bottom carriage.

k. Remove top carriage from bottom carriage and place on two wood timbers high enough to prevent damage to pintle which is still in top carriage (wood timbers, 8 in. x 8 in. x 4 or 5 ft long). **NOTE:** The elevating and traversing mechanisms come away with the top carriage. They are removed as described in paragraphs 63 and 70. Pintle cannot be removed until elevating gear shaft is removed from top carriage.

31. REMOVE BOGIE.

a. Remove bogie lifting screw lock C63704 by unfastening snap (fig. 52).

b. Remove bogie lifting screw covers D33759 by untying leather thongs and lifting covers off outer screws C7181 (fig. 52).

c. Remove the four wheel supporting cables B166592 from the upper torque rod hooks B159945 and place in position on the cross-beam torque bracket bolts A174244 (fig. 53).

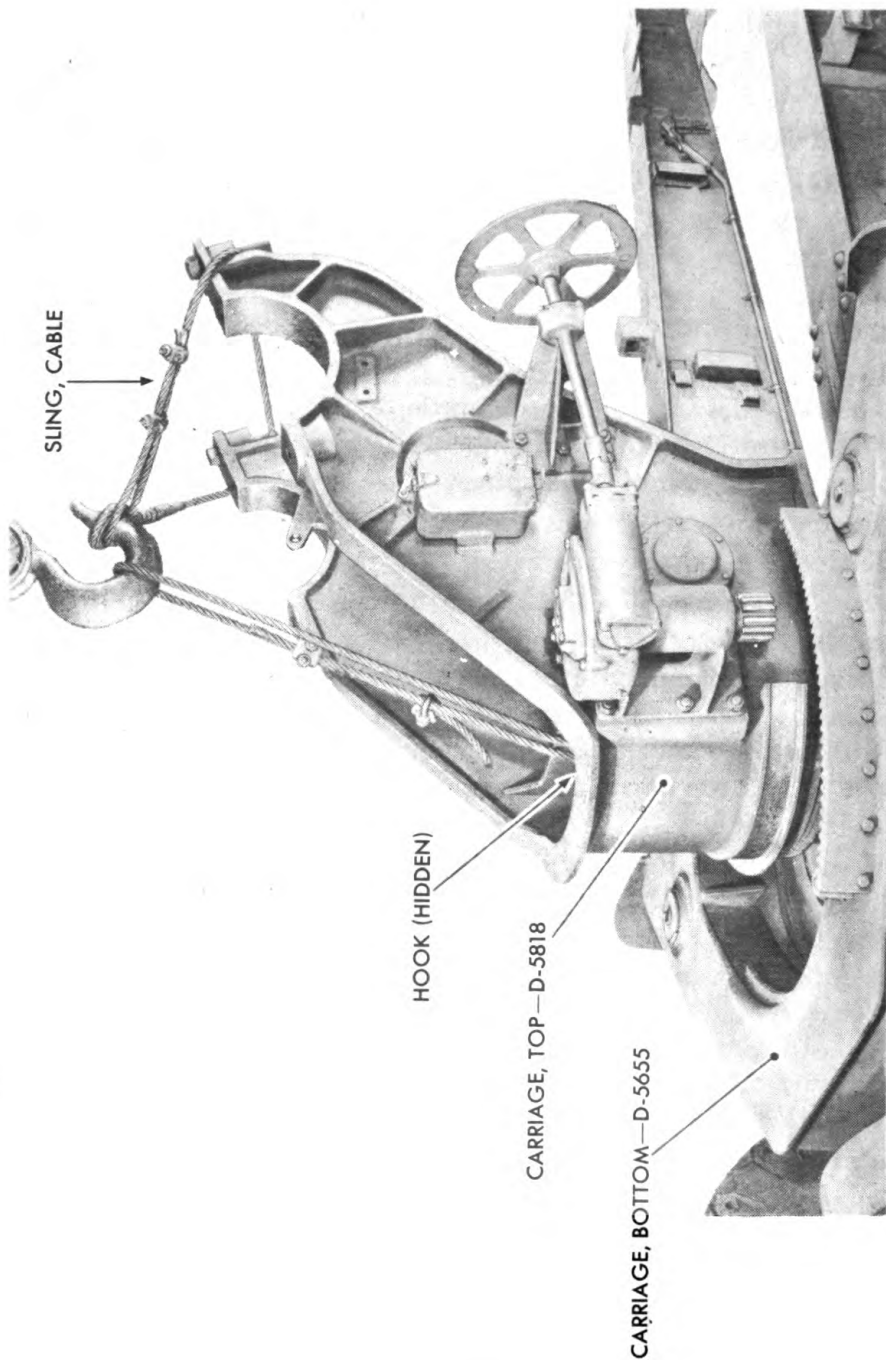
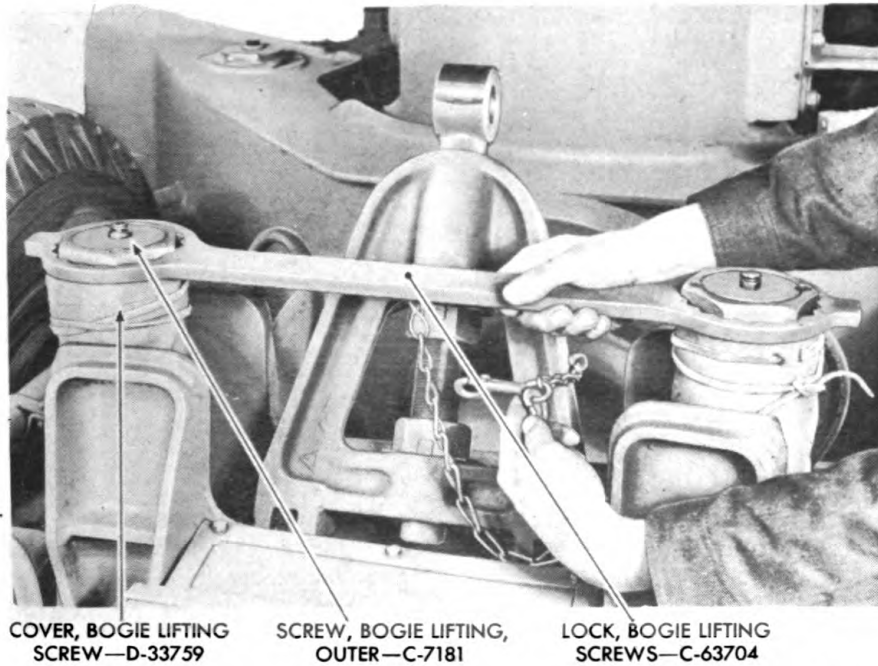


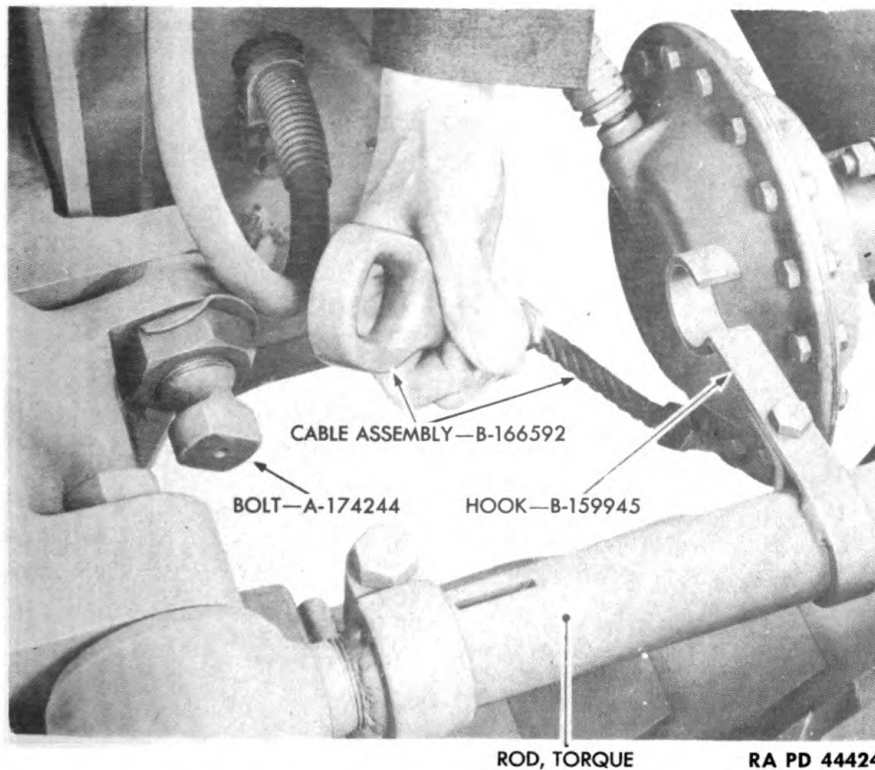
Figure 51 — Removing Top Carriage

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE



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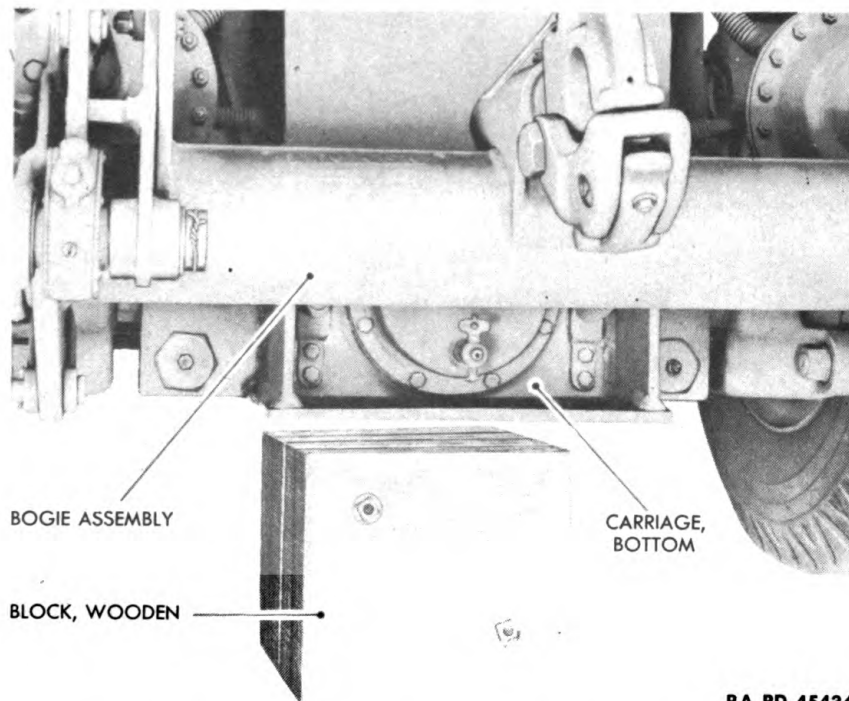
Figure 52—Removing Bogie Lifting Screw Lock



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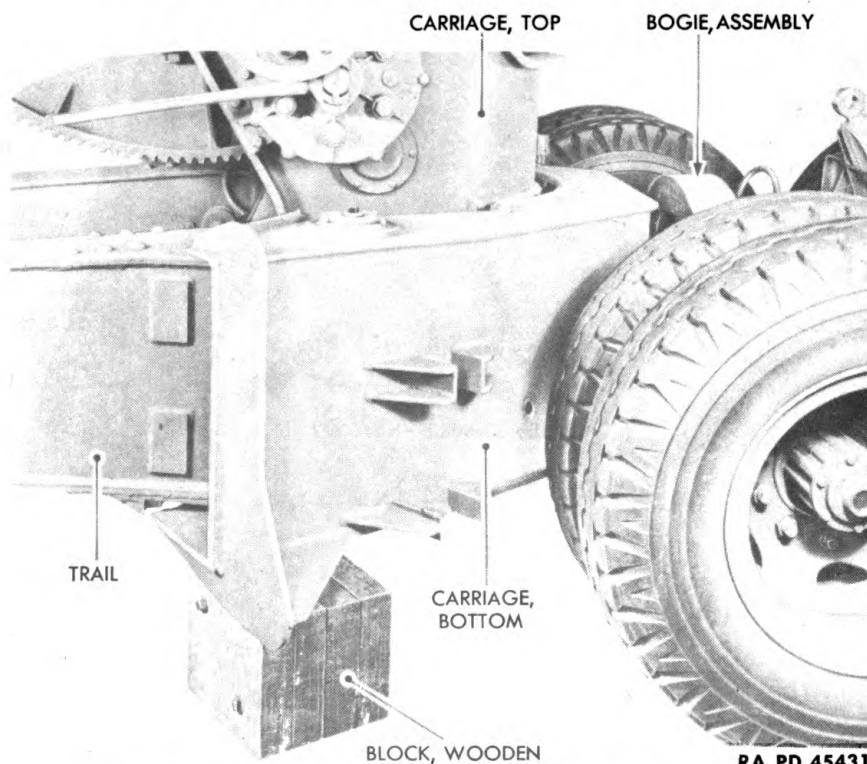
Figure 53—Placing Cable on Crossbeam Torque Bracket Bolt

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 45434

Figure 54—Blocking Front of Bottom Carriage



RA PD 45431

Figure 55—Blocking Sides of Bottom Carriage

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

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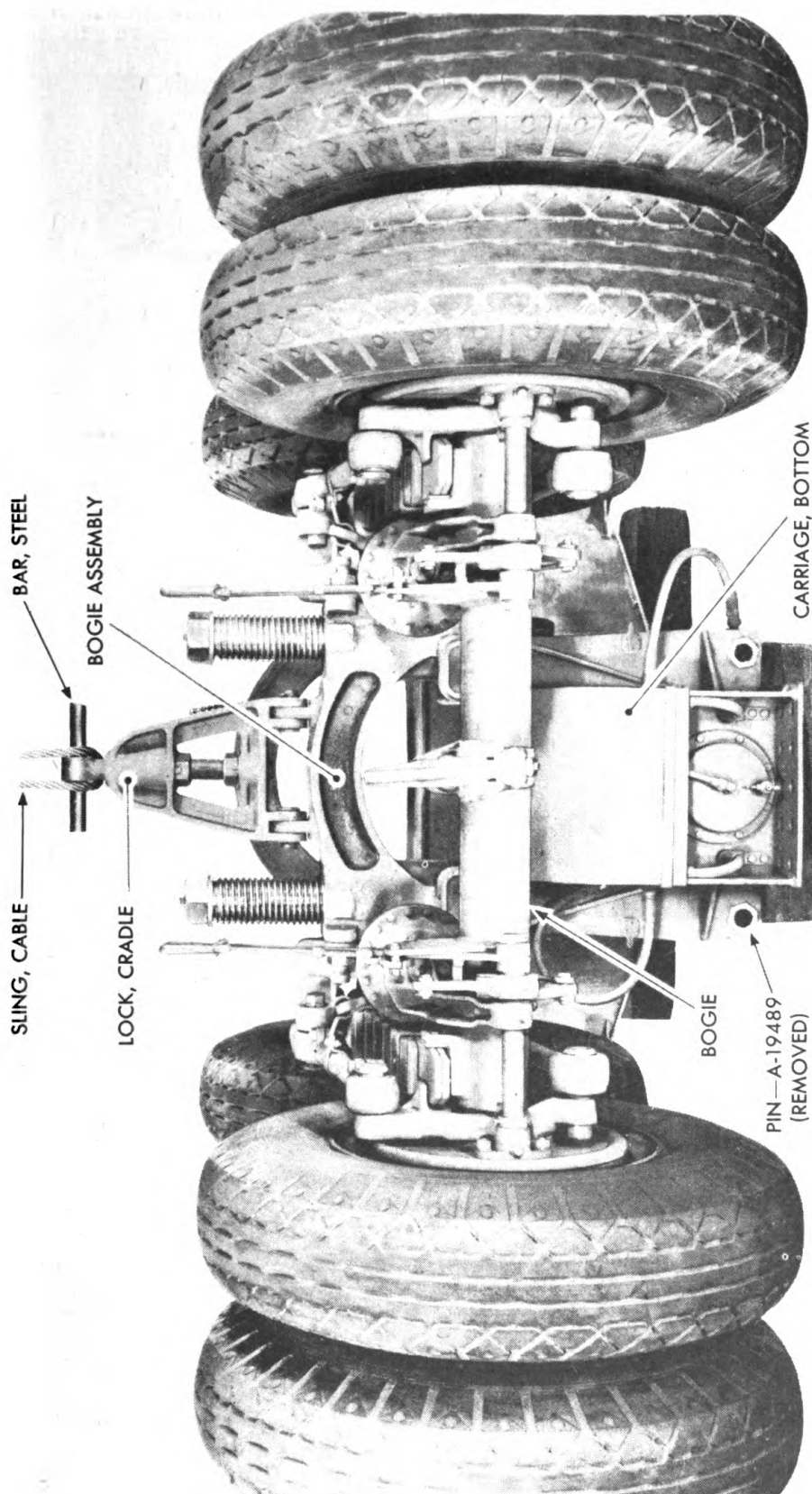


Figure 56—Removing Bogie from Bottom Carriage

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

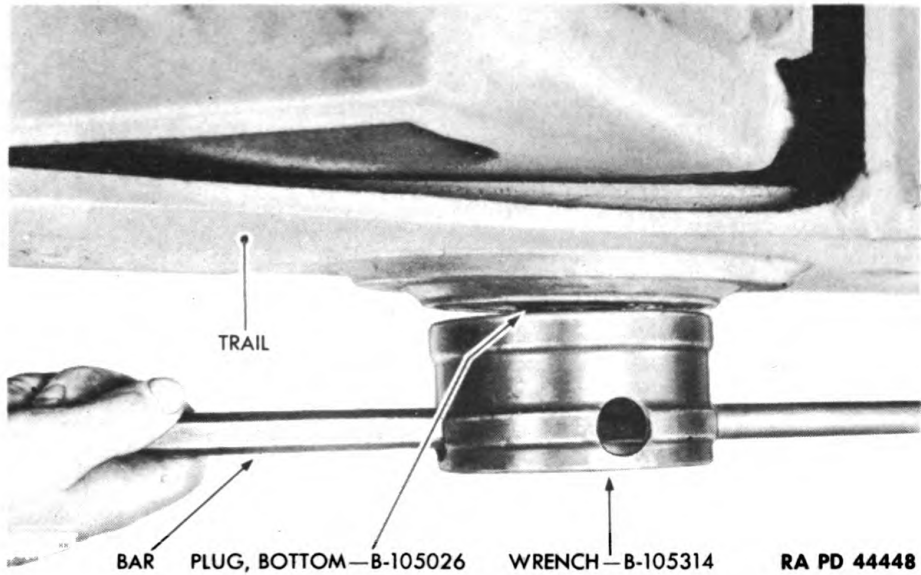


Figure 57—Removing Trail Hinge Pin Bottom Plug

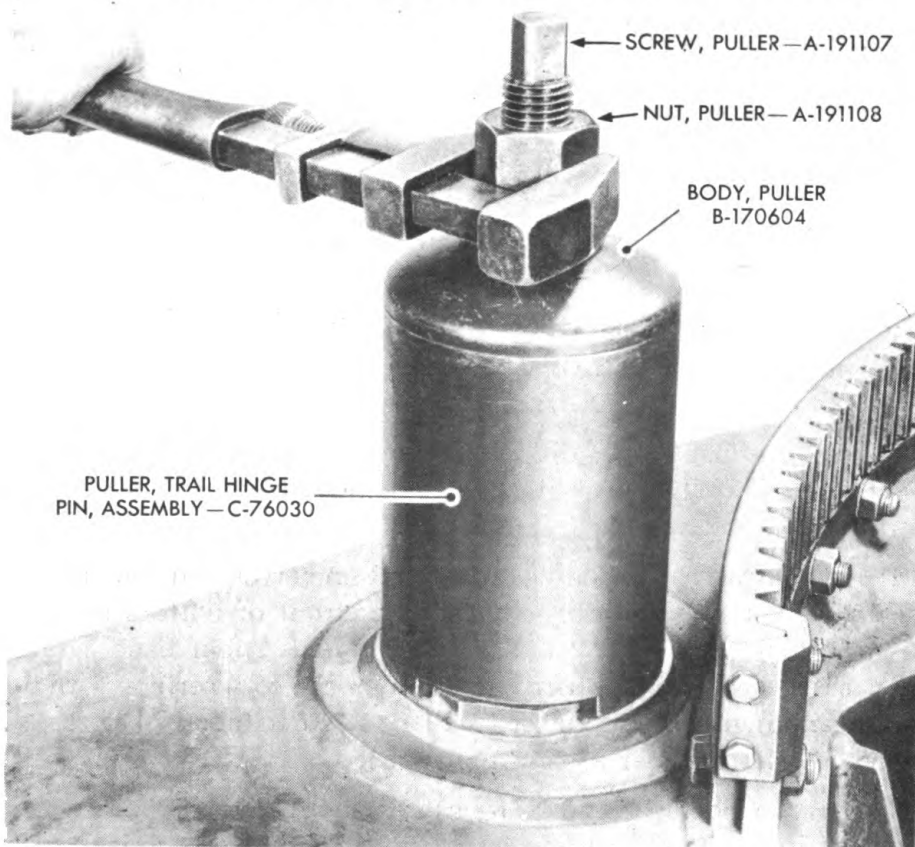


Figure 58—Pulling Trail Hinge Pin

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

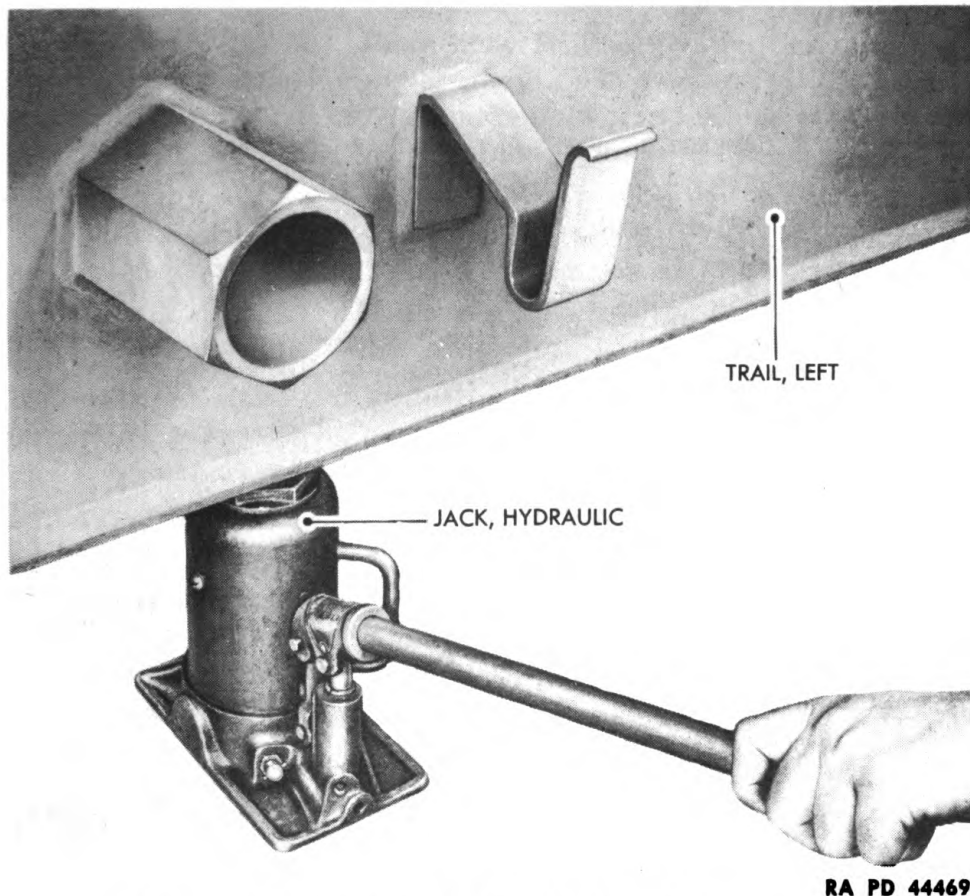
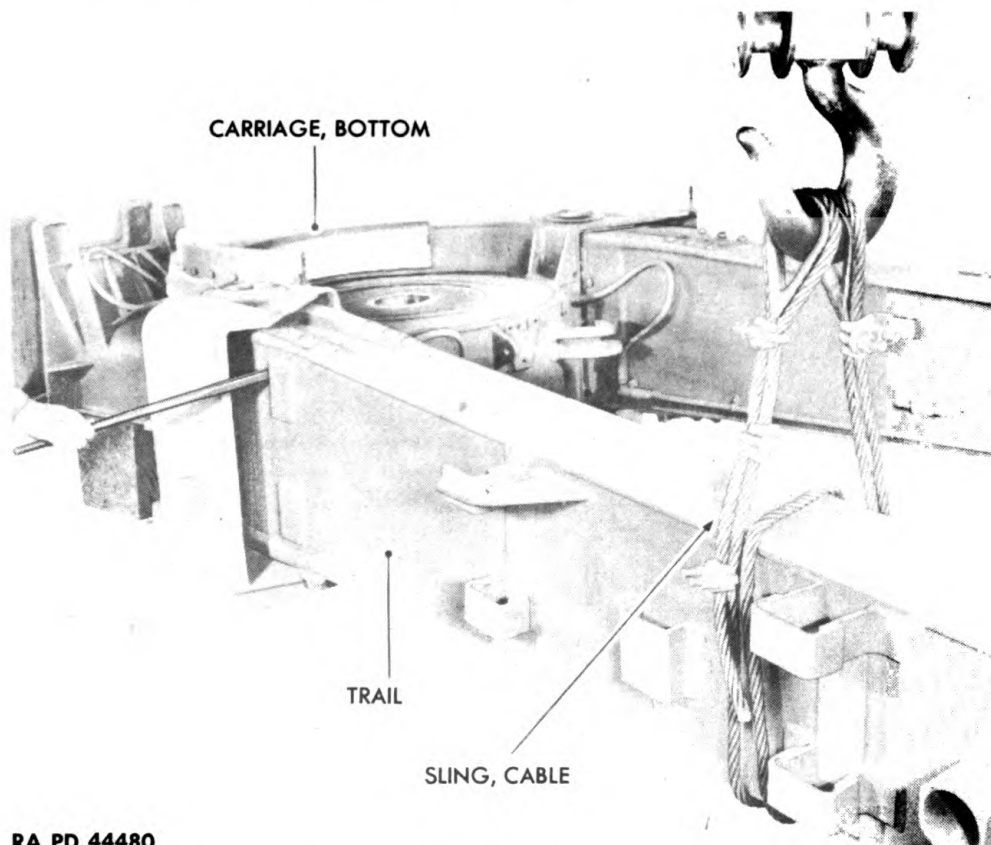


Figure 59—Lifting Trail Weight Off Hinge Pin

- d. Disconnect the air line hoses at the four brake diaphragms.
- e. Remove cotter pins BFAX2AD from the two bogie attachment pins A19489 and nuts BBFX3B.
- f. Loosen nuts BBFX3B on pins A19489 by turning nuts off with open-end wrench TKKX8F, while holding pinhead with bogie trunnion nut and lifting screw shackle pin wrench B105336.
- g. Place heavy wood blocking under bottom carriage at four places. Use a block 24 x 12 x 14 inches *high* under front of bottom carriage (fig. 54) and blocks 24 x 12 x 12½ inches *high* under each side of bottom carriage (fig. 55). Place blocks so as not to interfere with removal of trail hinge pin bottom plugs. Place a fourth block 24 x 12 x 12 inches *high* under the rear of bottom carriage.
- h. Using two bogie lifting screw ratchet wrenches C7357 to turn the bogie lifting screws, raise the bogie until the bottom carriage rests firmly and securely on the four wood blocks and all weight is off pins A19489.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44480

Figure 60—Removing Trail

i. Remove the nuts BBFX3B (previously loosened) from pins A19489 and tap pins out.

j. Place a round steel bar 12 inches long x $1\frac{3}{8}$ -inch diameter through hole in cradle lock eyebolt (fig. 56). Then, place a heavy cable sling around the steel bar, attach sling to crane lift hook, and lift bogie assembly away from bottom carriage.

32. REMOVE TRAILS.

a. Disconnect brake airline hose A140643 from bracket B166469.

b. Disconnect the airline hose connectors A144525A at air filter (fig. 234).

c. Remove screw BCKX2CK from trail hinge pin bottom plug B105026.

d. Remove bottom plug B105026 with trail hinge pin socket wrench B105314 and small pinch bar (fig. 57).

e. Remove plug A173855 from top of trail hinge pin.

f. Insert puller screw A191107 of trail hinge pin puller C76030 in

DISASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

trail hinge pin (fig. 58). Place body B170604 in position over screw and trail hinge pin. Run puller nut A191108 on screw. Tighten and pull trail hinge pin out of trail and bottom carriage high enough to lift out. **CAUTION:** Mark each trail hinge pin so it will go back in the same location.

g. In cases where the trail hinge pin is difficult to remove because of binding, place a hydraulic jack of at least 5-ton capacity under trail near the middle. Raise and lower trail with jack until trail weight is off the trail hinge pin (fig. 59).

h. Where tightness of pin is due to lack of lubrication, pour OIL, lubricating, preservative, light, down around trail hinge pin and proceed as in subparagraph f above.

i. Wrap a heavy cable sling around the trail just ahead of spade rear brackets (fig. 60). (This is approximately center of trail weight.) Secure sling to crane lift hook and lift trail until weight is balanced and the trail is free to swing in bottom carriage bearings.

j. With one man pulling back on trail and another using a pinch bar (fig. 60), remove the trail from bottom carriage.

k. Replace trail hinge pin top plug A173855.

l. Repeat subparagraph a through k above for removal of other trail.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

Section VIII

FIRING MECHANISM M1

	Paragraph
General	33

33. GENERAL.

a. Complete description and operation of the Firing Mechanism M1 is contained in paragraph 8 of TM 9-335 and paragraph 6 of TM 9-350. Malfunctions are covered in paragraph 55 a of TM 9-335 and paragraph 40 a of TM 9-350. Disassembly and assembly are covered in paragraphs 63 and 64 of TM 9-335 and paragraphs 46 and 47 of TM 9-350.

b. An exploded view of the firing mechanism is shown in figure 61.

FIRING MECHANISM M1

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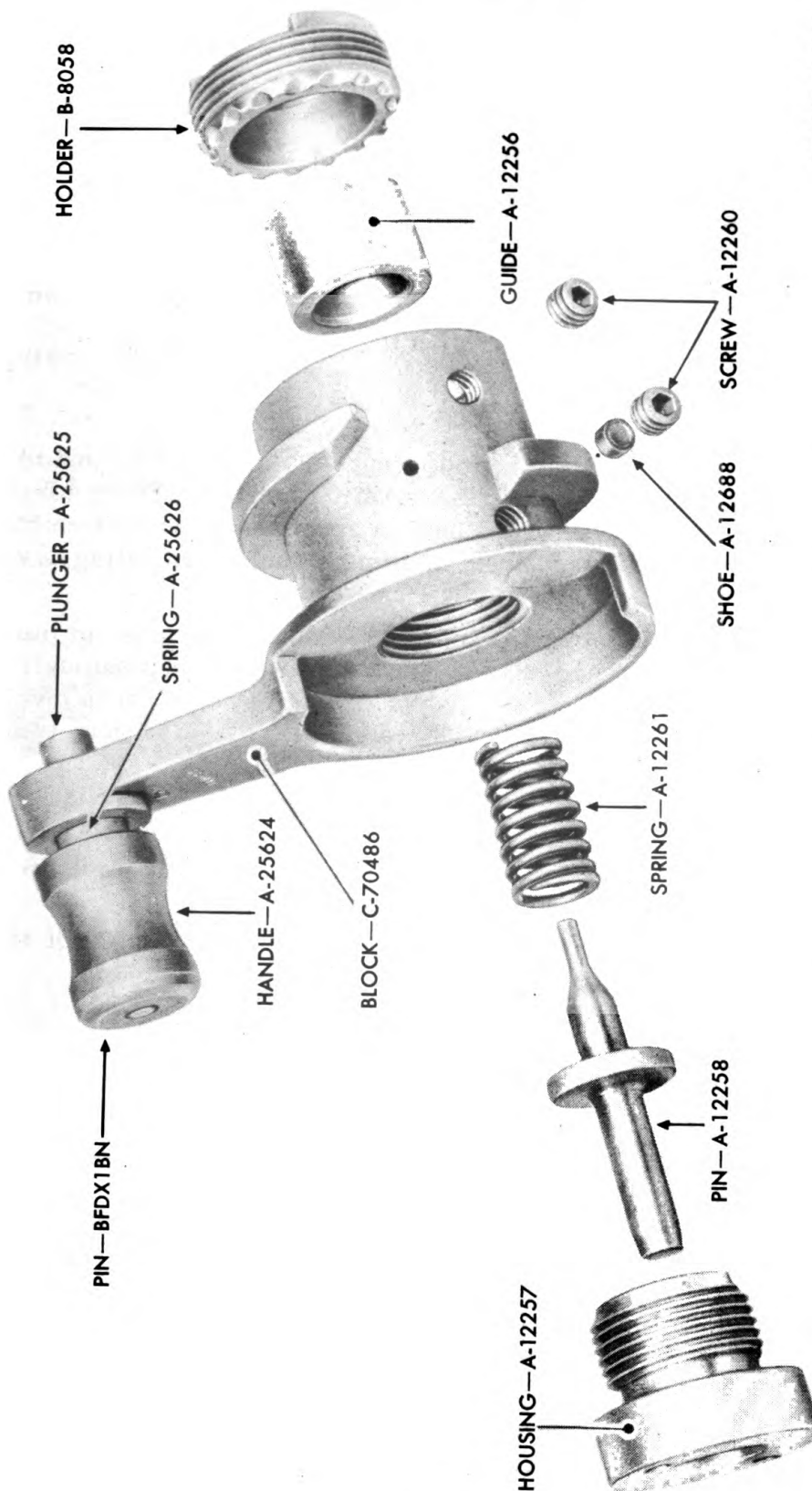


Figure 61 — Firing Mechanism M1 — Exploded View

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

Section IX

BREECH MECHANISM

	Paragraph
General	34
Malfunctions	35
Disassemble breech mechanism	36
Maintenance and repair of breech mechanism	37
Assemble breech mechanism	38

34. GENERAL.

a. The breech mechanism group (figs. 62, 63, and 64) includes the breechblock assembly, breechblock carrier assembly, Firing Mechanism M1 assembly, firing mechanism receiver housing assembly, firing mechanism safety plunger housing assembly, operating lever assembly, obturator group, and hinge pin assembly.

b. Description and operation of these parts are contained in paragraphs 6 through 8; 28 and 29, TM 9-335, and paragraphs 4 through 7; 22 and 23, TM 9-350. Disassembly and assembly of the breech mechanism are covered in paragraphs 67 and 68, TM 9-335, and paragraphs 50 and 51, TM 9-350.

35. MALFUNCTIONS.

a. Breech mechanism malfunctions are covered in paragraph 55 d, TM 9-335 and paragraph 40 d, TM 9-350.

b. Breech mechanism repairs are covered in paragraph 37 of this manual.

36. DISASSEMBLE BREECH MECHANISM.

a. Disengage Counterbalance (par. 65 a, TM 9-335 or par. 48, TM 9-350).

b. Remove Firing Mechanism Safety Plunger Housing Assembly.

(1) Remove screw BCKX2EH, screw A25620, and washer A25621 from safety plunger housing B8486 (fig. 62).

(2) Using a scribe or thin-bladed knife, push detent A25312 away from lock A25619. Then, holding detent out of engagement with lock, turn lock to the left, and withdraw it.

(3) Remove safety plunger housing assembly (fig. 65).

c. Remove Firing Mechanism Receiver Housing Assembly and Obturator Spindle Group.

CAUTION: Never unscrew firing mechanism receiver housing as-

BREECH MECHANISM

- A — RING, BREECH, ASSEMBLY
- B — KNOB - A-25306
- C — HAMMER - B-8485
- D — HOUSING - C-70425
- E — SCREW - A-25314
- F — CAM - C-3730
- G — SCREW - A-25317
- H — PIN - A-25310
- J — ROLLER - A-25311
- K — PIN - BFAX1EN
- L — CUP - CLFX2C
- M — LEVER, OPERATING, ASSEMBLY
- N — MECHANISM, FIRING, M1,
ASSEMBLY - C-70485
- P — DETENT - A-25312
- Q — CARRIER, ASSEMBLY
- R — HANDLE - A-25322
- S — SCREW - BCKX2EH
- T — PIN - A-207507
- U — BOLT - B-8482
- V — HOUSING - B-8486
- W — PLUNGER - B-8491
- X — LOCK - A-25619
- Y — SCREW - A-25620
- Z — WASHER - A-25621
- Z — PIN ASSEMBLY - C-70575

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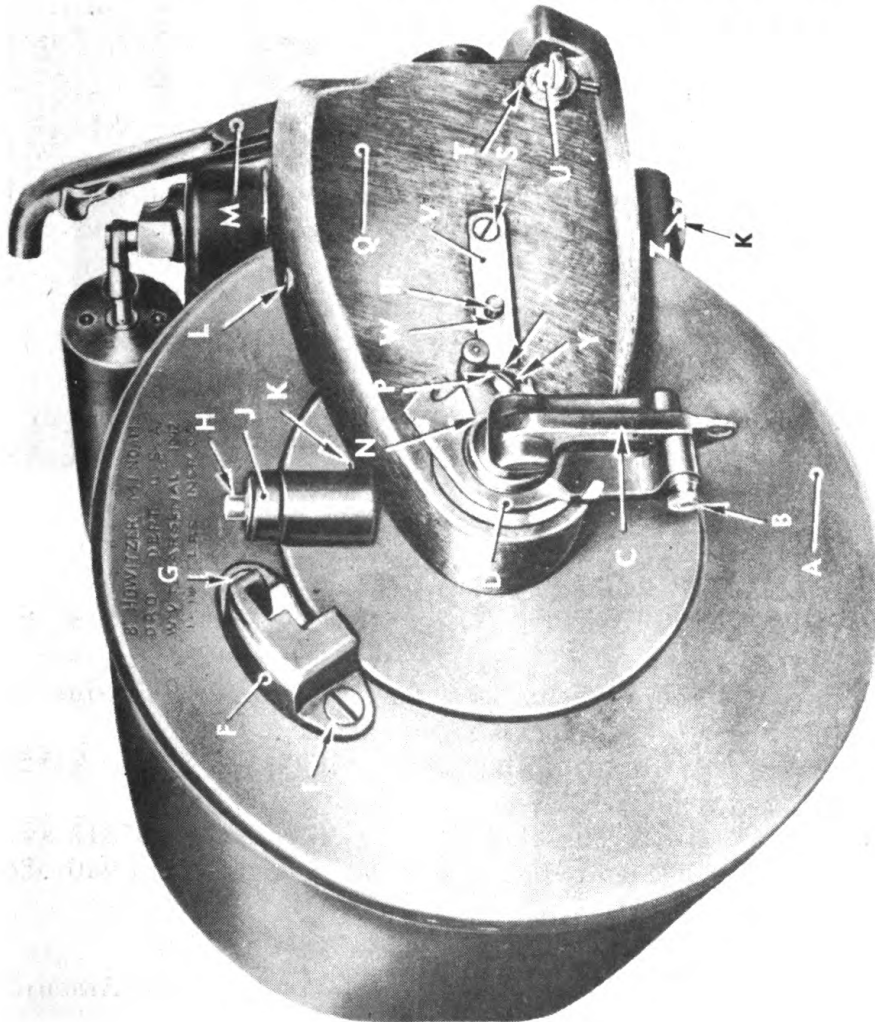
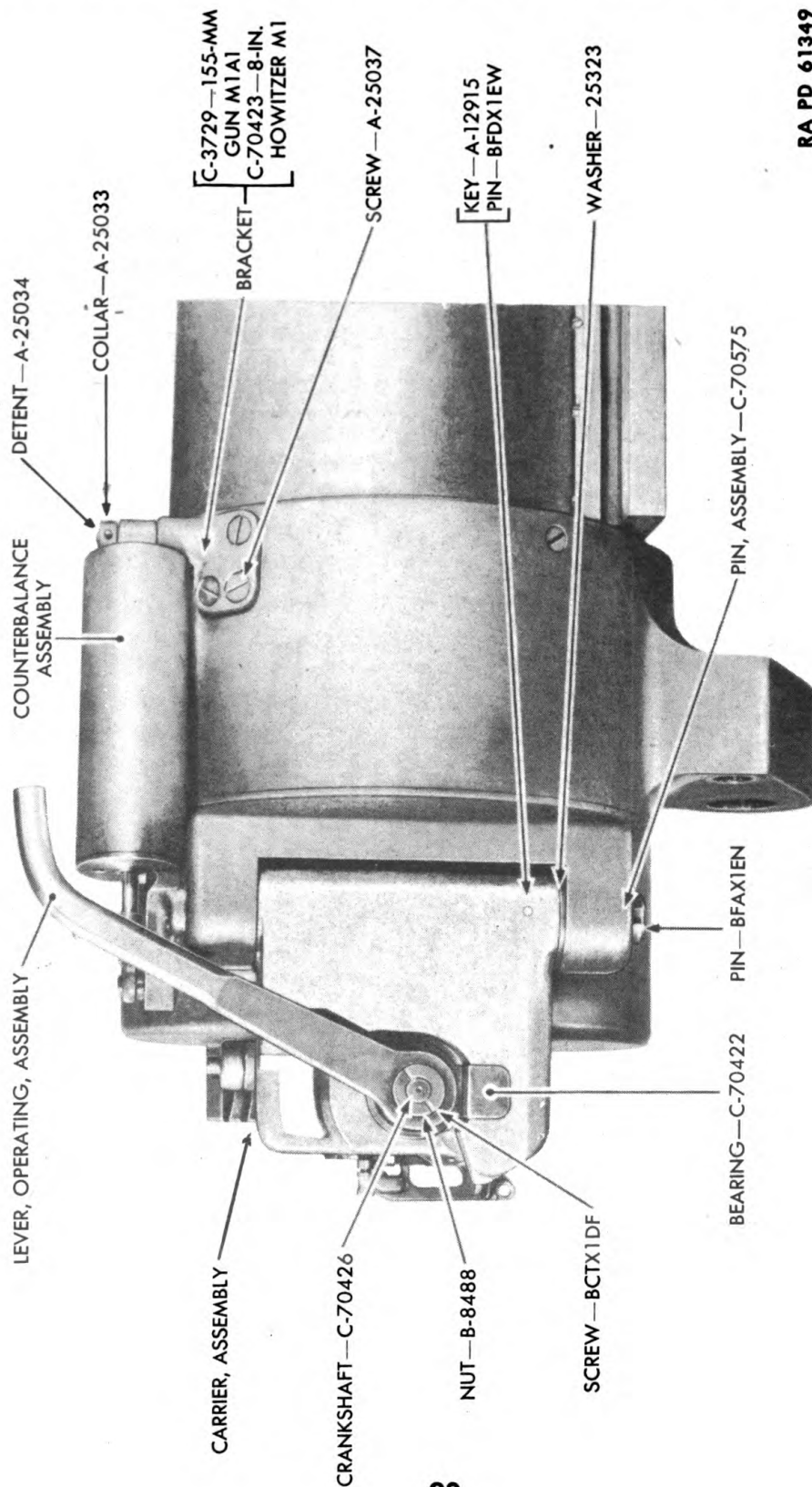


Figure 62—Breech Mechanism—Closed

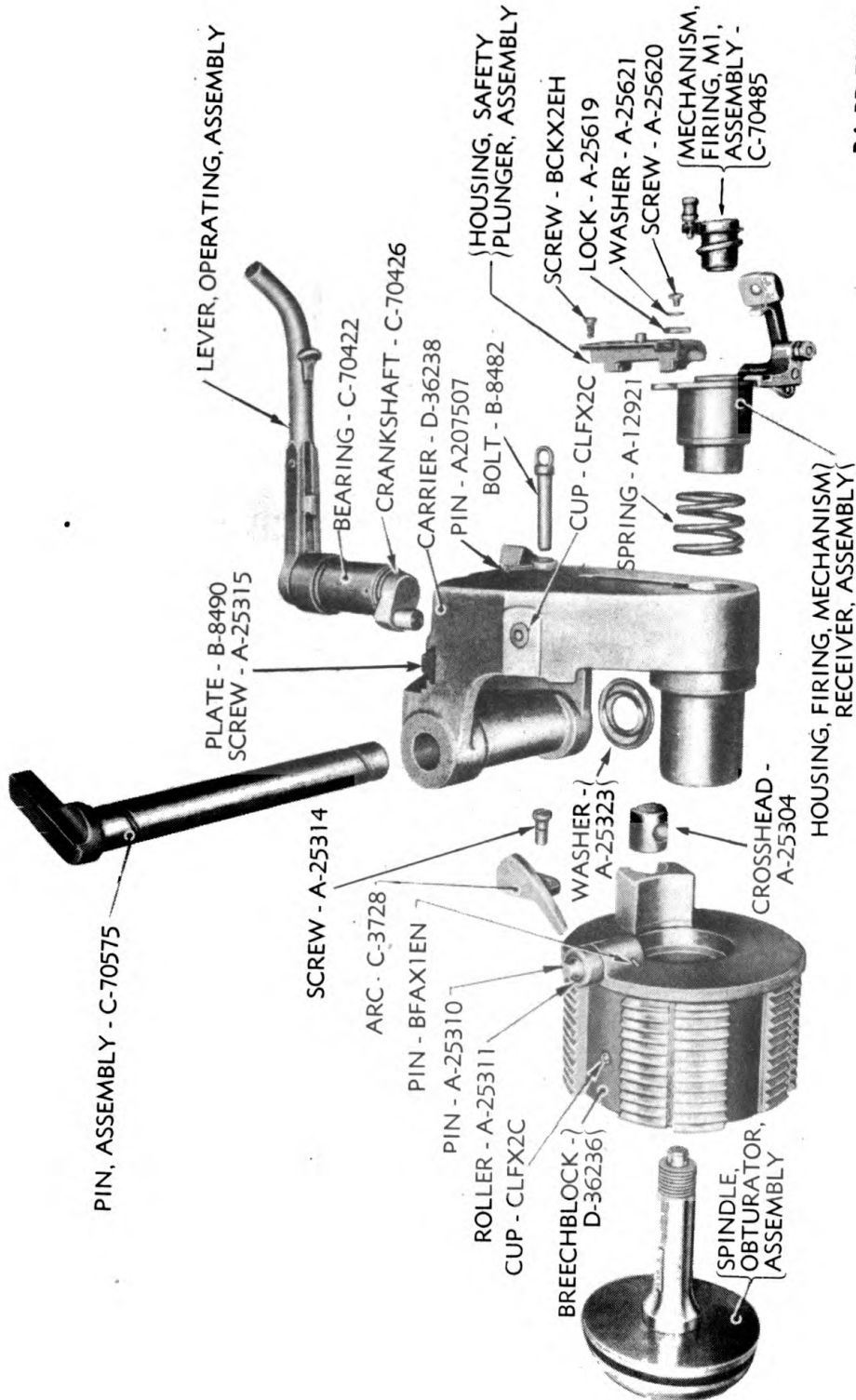
ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



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Figure 63—Breech Mechanism—Side View

BREECH MECHANISM

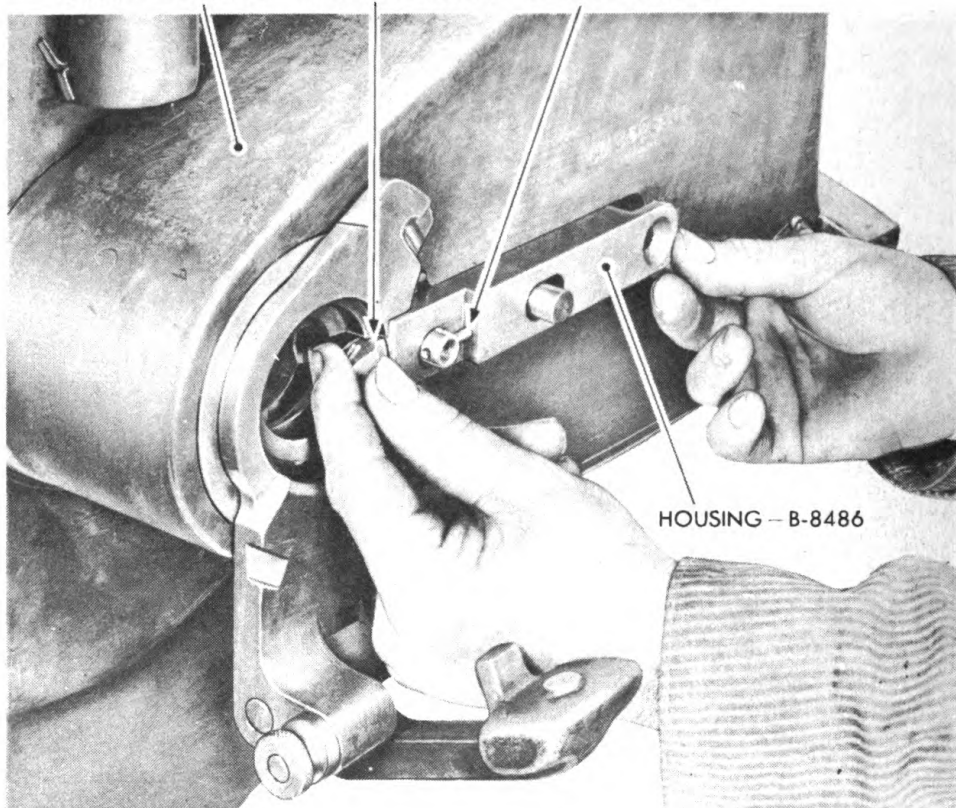


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Figure 64—Breech Mechanism—Exploded View

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

CARRIER—D-36238 PLUNGER—B-8491 DETENT—A-25312



RA PD 45341

Figure 65—Removing Safety Plunger Housing Assembly

sembly from its fully assembled position on rear end of obturator spindle until breech has been opened.

(1) While one man holds obturator spindle against breechblock, another man should unscrew and remove firing mechanism receiver housing assembly.

(2) Push obturator spindle back through the carrier with a hammer handle. Withdraw obturator spindle, obturator split rings, obturator inner ring, gas-check pad and filling-in disk from breechblock.

(3) Remove spring A12921 from carrier (fig. 64).

d. Remove Breechblock Assembly.

(1) Remove screws A25314 from arc C3728 and breech ring. Remove arc (fig. 66).

(2) Slide a wood pole, 1 $\frac{3}{4}$ -inch diameter x 4 feet long, through breechblock D36236. With one man holding the pole and another working the operating lever up and down, and at the same time pushing the breechblock back on the pole, remove the breechblock. Carefully lift breechblock (on pole) away from breechblock carrier D36238.

BREECH MECHANISM

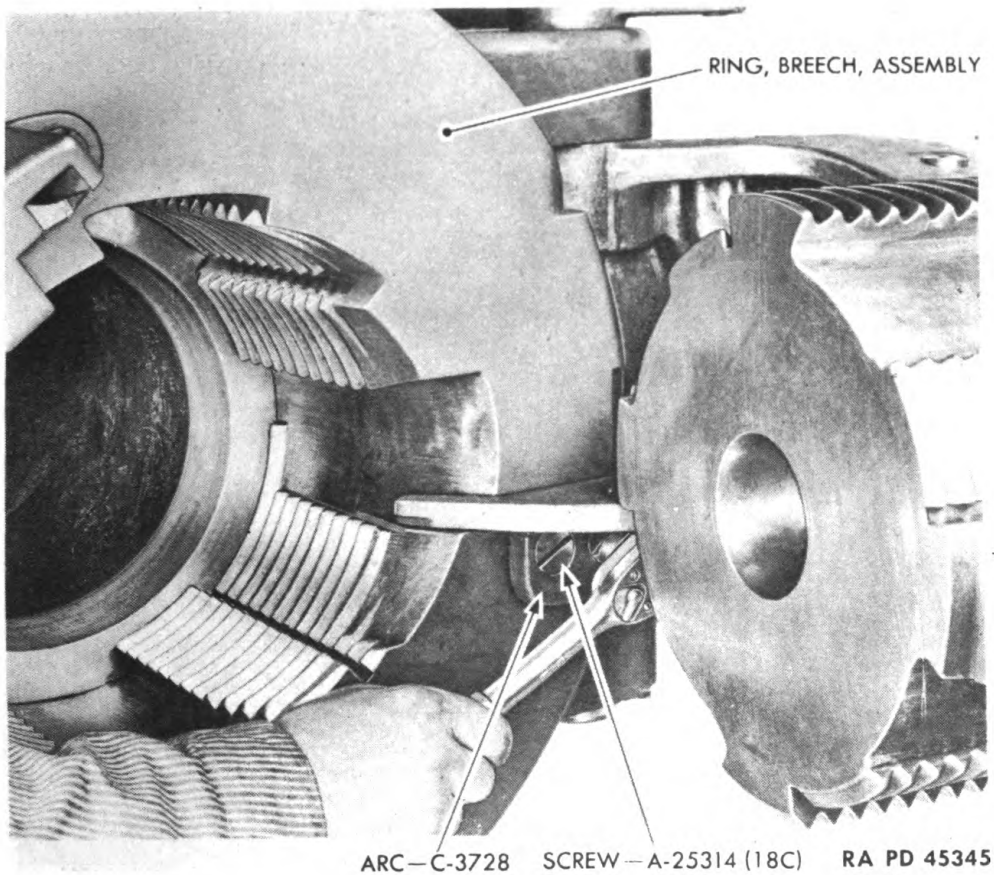


Figure 66—Removing Breechblock Control Arc

e. Remove Operating Lever Assembly.

(1) Remove cotter pin A207507 from carrier and bolt B8482 and remove bolt (fig. 62).

(2) Work operating lever up and down easily, and at same time pull out on operating lever to remove crosshead A25304.

(3) Swing the carrier to closed position, and withdraw operating lever, bearing C70422, and crankshaft C70426 from carrier, as a unit (fig. 64).

f. Remove Breechblock Carrier Assembly.

(1) Remove cotter pin BFAX1EN from hinge pin assembly (fig. 62).

(2) With the carrier still in the closed position, pry up on hinge pin assembly C70575 and remove hinge pin assembly.

(3) Remove carrier from carrier lugs on breech ring. The carrier is quite heavy; get a good hold of it before attempting to pull it from the lugs. Lift washer A25323 from lower lug (fig. 64).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

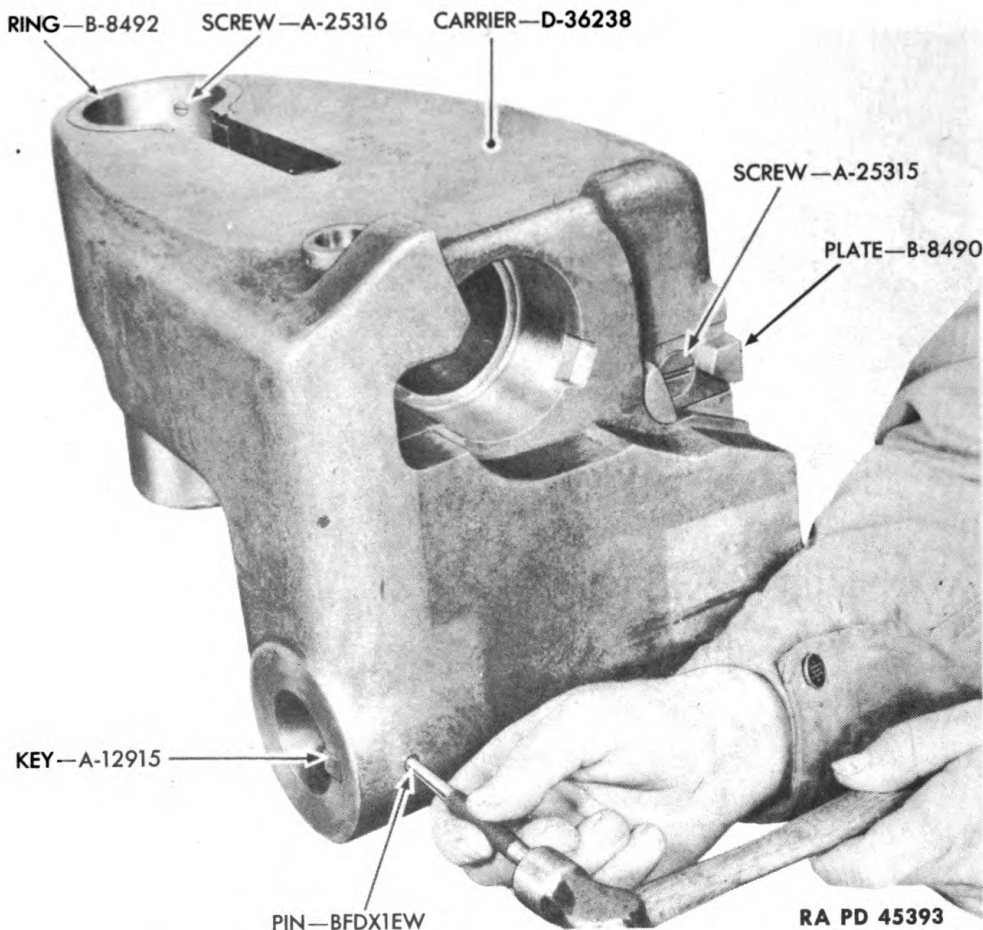


Figure 67—Removing Breechblock Carrier Key

g. Disassemble Carrier Assembly (fig. 67).

- (1) Remove key A12915 by driving out pin BFDX1EW.
- (2) Remove plate B8490 by removing screw A25315.
- (3) Remove ring B8492 by removing screws A25316.

h. Disassemble Operating Lever Assembly.

- (1) Place operating lever assembly on a clean workbench and remove screw BCTX1DF and nut B8488 (fig. 68).
- (2) Slide crankshaft C70426 and bearing C70422 off lever.
- (3) Place a small wood block under lever handle and drive out pin A25309.
- (4) Slide catch C3668, spring A25321, and block A25302 down, as a unit, into lever D1762; then pull out and up to remove them.
- (5) Remove block and spring from catch by taking hold of spring while prying up on block.

BREECH MECHANISM

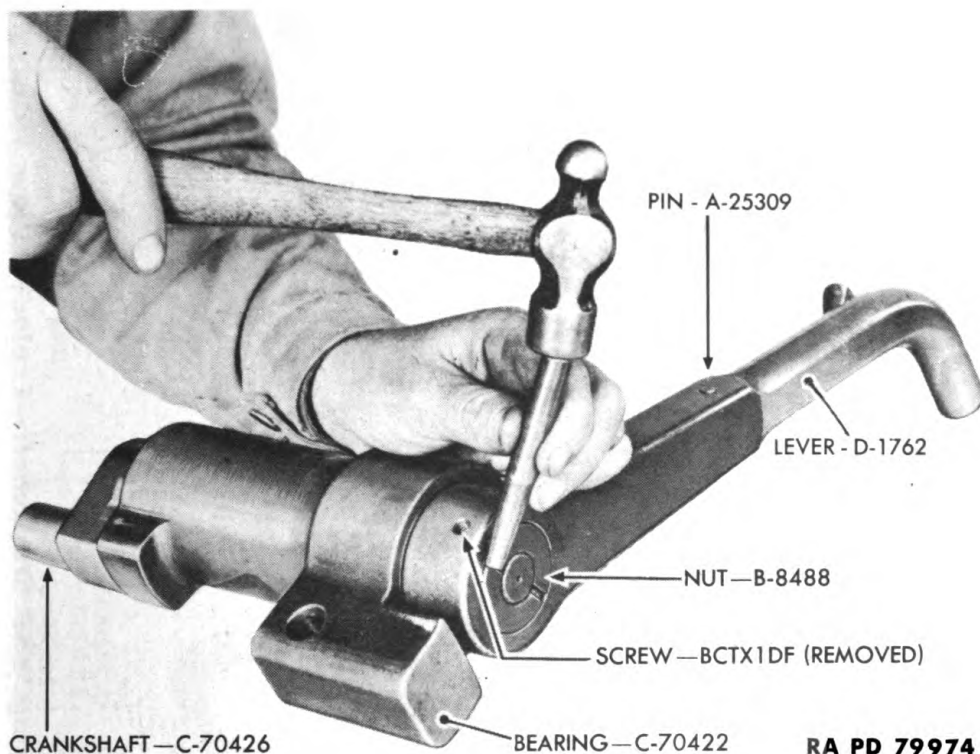


Figure 68—Removing Operating Lever Crankshaft Nut

(6) The operating lever is now completely disassembled (fig. 69).

NOTE: Two types of breechblock operating lever having different degrees of hardness are currently in use on the 155-mm Gun M1A1. Both have the same piece mark, D1762. The one of greater hardness has the grip end painted red; the other does not. The lever of greater hardness will be installed on all 155-mm Guns M1A1 in service (FSMWO-D24-W8).

i. Remove Roller from Breechblock.

(1) The only part still attached to the breechblock D36236 is the breechblock roller A25311 (fig. 64). When necessary to remove this roller, remove cotter pin BFAX1EN, and pull out on pin A25310. Roller will come away with pin.

j. Disassemble Obturator Spindle Group (fig. 70).

(1) Carefully remove filling-in disk, inner ring gas-check pad and split rings from obturator spindle.

(2) To remove plug B241, unscrew it from obturator spindle. Maintenance and repair of obturator spindle are covered in paragraph 37. **NOTE:** This plug is not to be removed except when a new plug is to be installed.

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

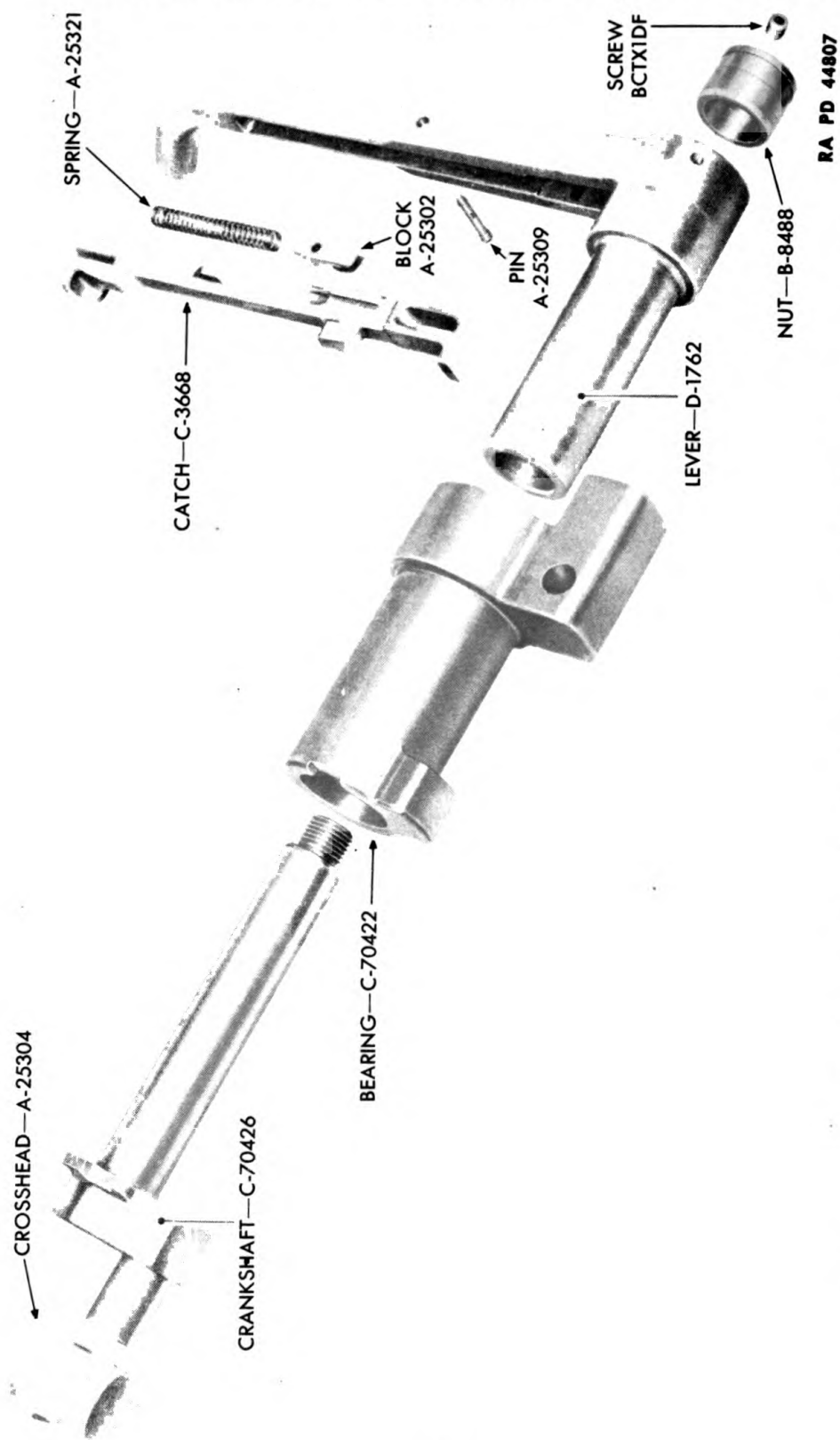


Figure 69—Breech Operating Lever, Bearing, and Crankshaft—Exploded View

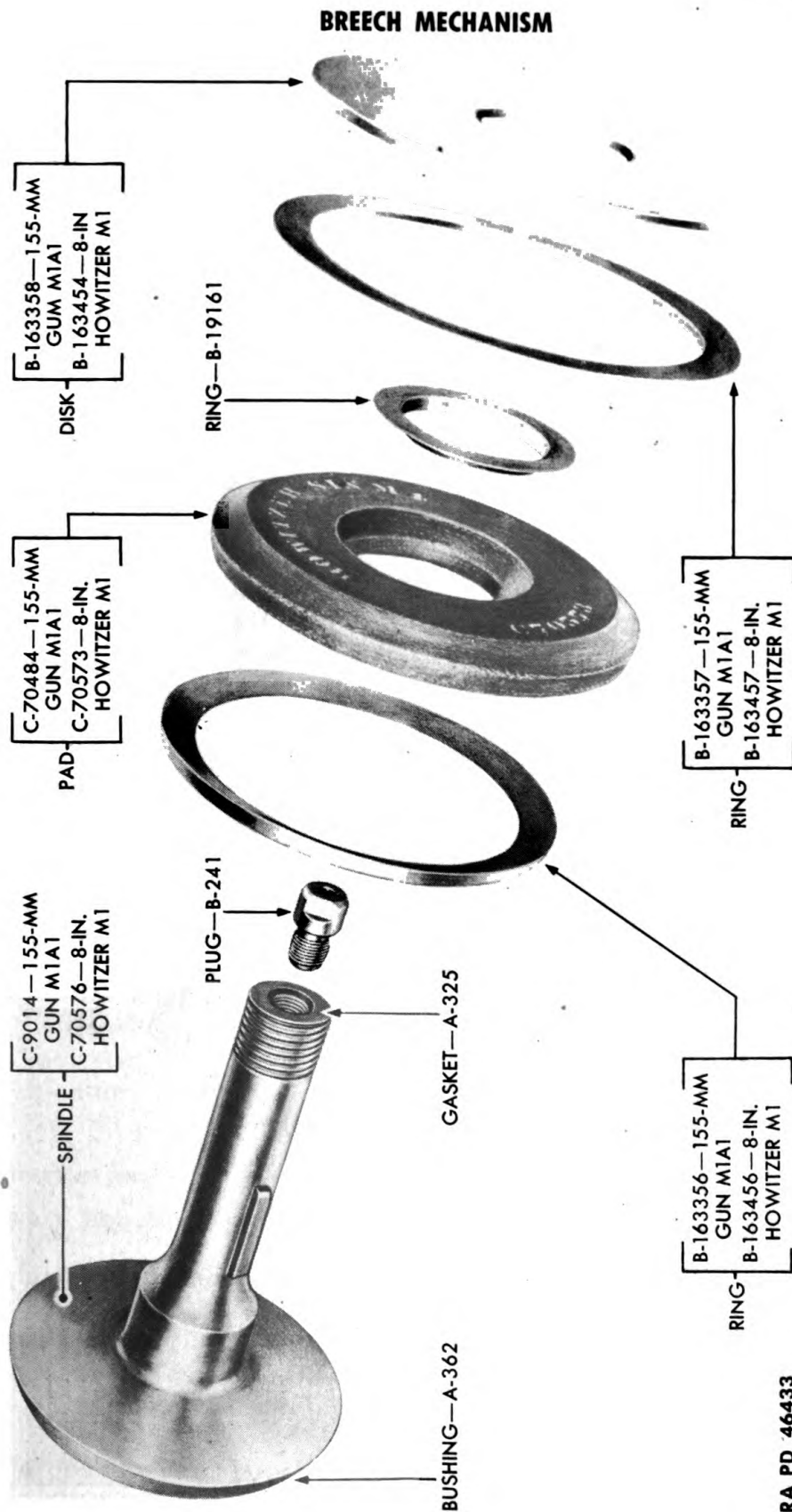


Figure 70—Obturator Spindle Group—Exploded View

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**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

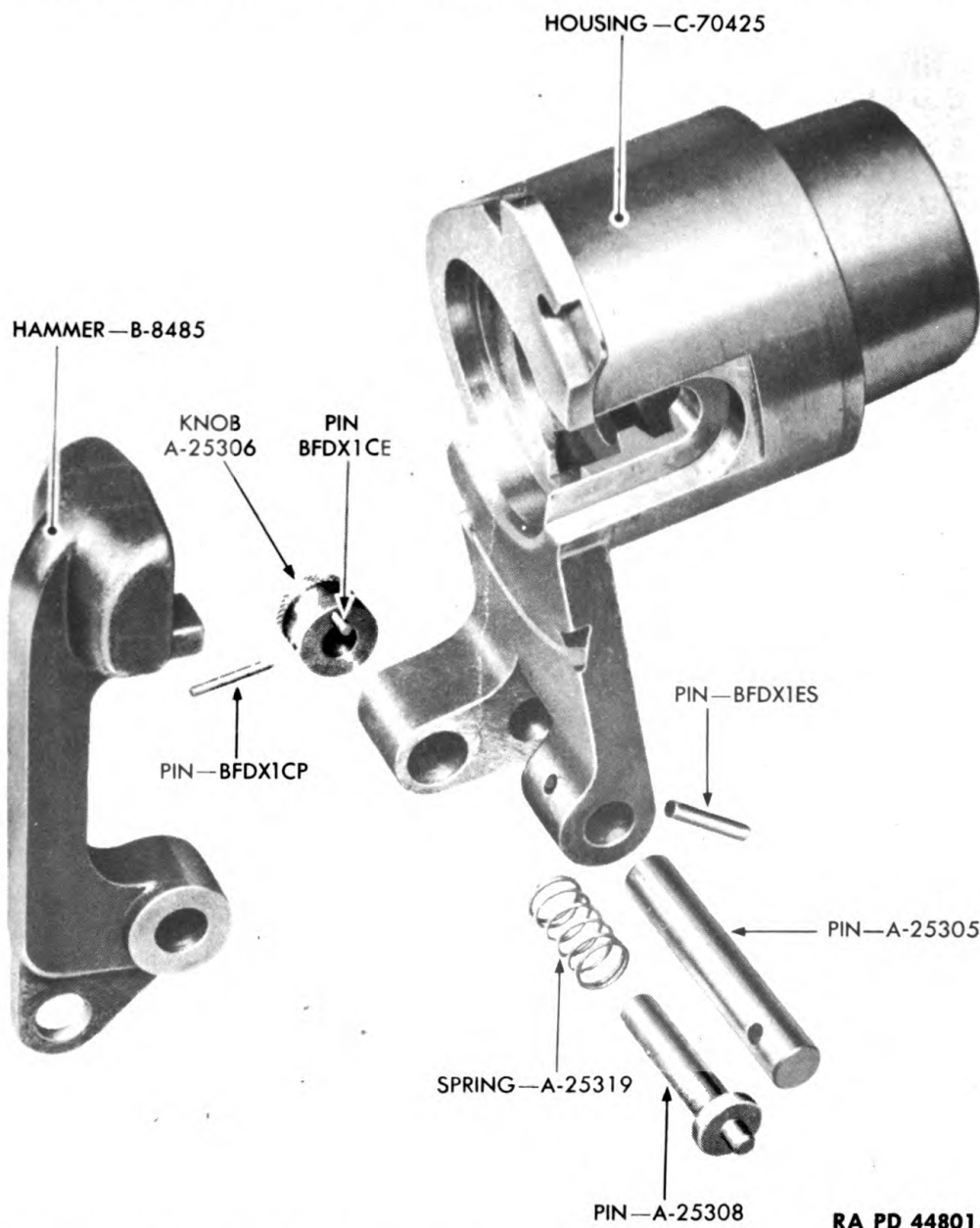


Figure 71—Firing Mechanism Receiver Housing—Exploded View

k. Disassemble Firing Mechanism Receiver Housing Assembly (fig. 71).

(1) Place the firing mechanism receiver housing assembly in a vise fitted with copper jaws. Drive pin BFDX1ES from pin A25305 and housing C70425; then drive pin A25305 out of housing and remove percussion hammer B8485.

(2) Remove pin BFDX1CP from knob A25306 and pull knob off. Tap locking pin A25308 and spring A25319 out of housing C70425.

BREECH MECHANISM

1. Disassemble Firing Mechanism Safety Plunger Housing Assembly (fig.72).

(1) Place handle of firing mechanism safety plunger housing assembly in vise fitted with copper jaws. Turn housing to unscrew handle A25322.

(2) Slide plunger B8491 from housing B8486. Spring A25320 will drop out or come out in plunger.

(3) Press back on detent A25312 and let go of it quickly. Detent will be forced out by spring compression. Tap spring A25622 from housing B8486 in palm of hand.

37. MAINTENANCE AND REPAIR OF BREECH MECHANISM.

a. General.

(1) Clean all parts of the breech mechanism thoroughly in SOLVENT, dry-cleaning.

(2) Examine all parts carefully for cracks, wear, or breakage.

(3) Examine closely for cutting or abrasions on the pressure side of breechblock threads, and breech recess threads in breech ring. Remove scoring or bruises on threads with breech thread file B141012 and polish with CLOTH, crocus. CAUTION: Remove only enough metal to eliminate the score or bruise (fig. 73).

(4) Repair other burred or roughened parts in same manner as above.

(5) Replace worn or damaged parts.

b. Clean Obturator Spindle Vent and Spindle Plug Vent.

(1) Clean the vent in the obturator spindle and spindle plug with vent cleaning bit B19667.

(2) Clean and resize the primer seat in the obturator spindle plug with primer seat resizing reamer (fig. 74). If examination shows the need for a new spindle vent bushing or spindle plug, proceed as outlined in subparagraphs c and d below.

c. Replace Eroded Obturator Spindle Vent Bushing.

(1) Remove eroded bushing by means of a drill or counterbore. CAUTION: Do not damage threads in the obturator spindle.

(2) Run obturator spindle vent bushing seat gage tap B167299 in spindle to repair threads. Insert a new bushing, screwing it in tight.

(3) Finish the new bushing off flush with spindle by sawing or milling.

(4) Drill the vent hole to proper size. It may be necessary to weld a drill of proper size to a piece of drill rod in order to drill the vent hole in the new spindle vent bushing.

d. Replace Eroded Obturator Spindle Plug.

NOTE: An eroded primer seat in the obturator spindle plug causes

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

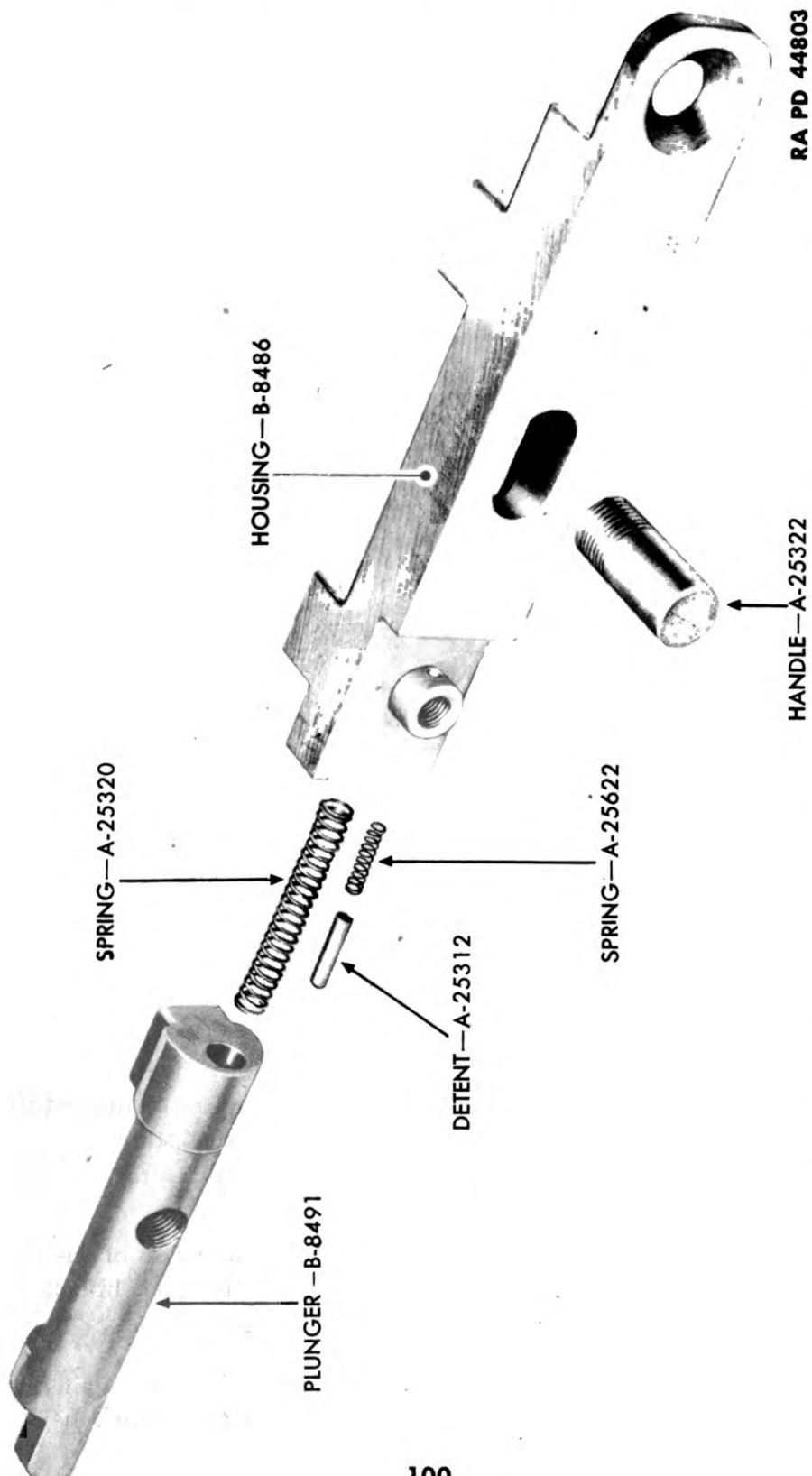


Figure 72—Firing Mechanism Safety Plunger Group—Exploded View

BREECH MECHANISM

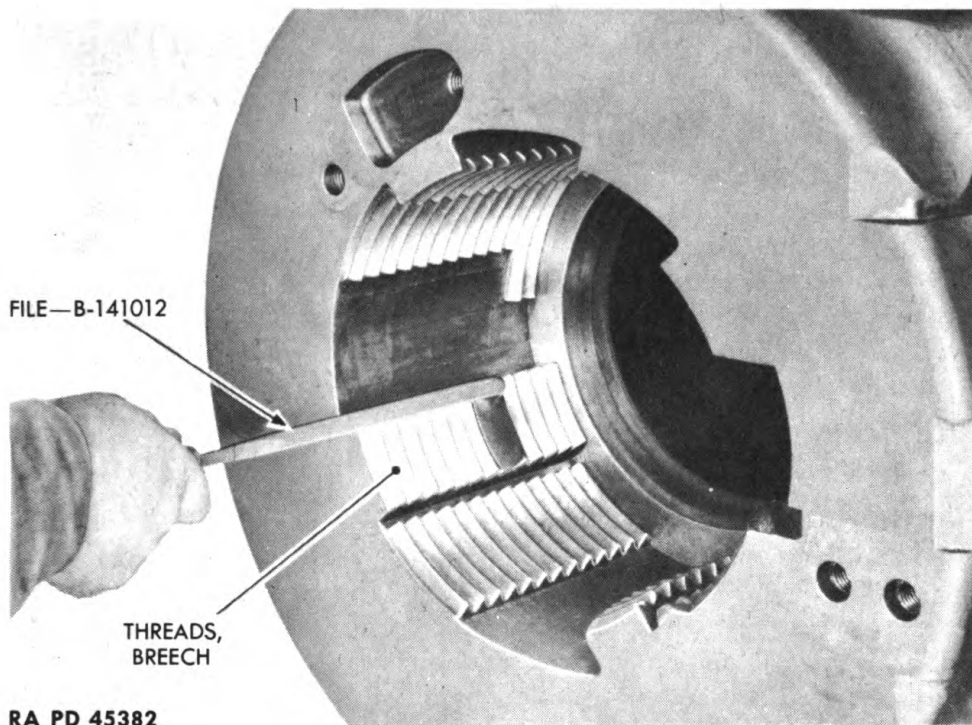


Figure 73—Repairing Bruised Breech Threads

a portion of the fired primer to burn out. In certain cases, pieces of primer remain in the primer seat after ejection of primer and, in extreme cases, "blow-out" may occur.

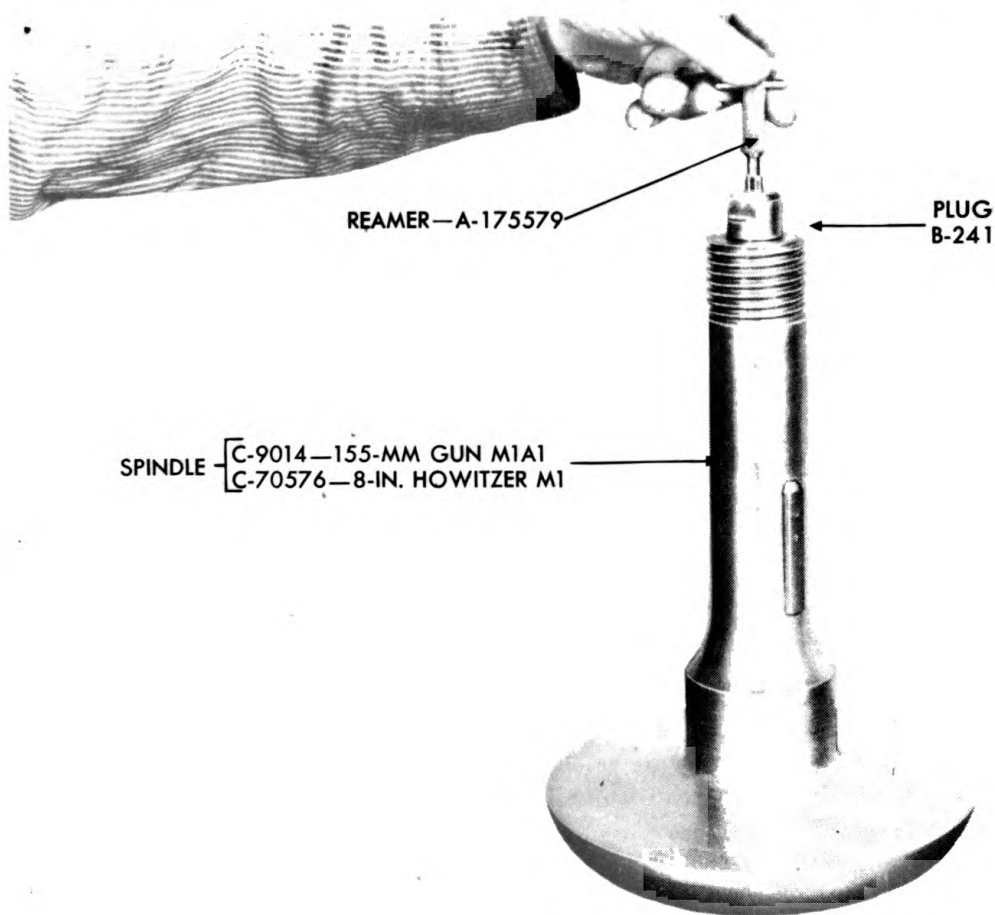
- (1) Unscrew and remove used obturator spindle plug.
- (2) Remove spindle plug gasket with a counterbore, having a body diameter slightly less than the inside diameter of the screw threads in the spindle and a teat with a running fit in the vent hole. Care should be taken not to remove any stock from obturator spindle, especially the bottom of the hole.
- (3) Replace gasket with a new one.
- (4) Replace used spindle plug with a new one.
- (5) Screw the plug tight against the gasket, compressing it to get the proper relation between the firing pin and the spindle.
- (6) Ream the vent hole in the new gasket to size.

e. Remove Seized Breechblock.

NOTE: The breechblock may be seized by expansion of the obturator, or the seizing may be in the threads of the breechblock and breech recess or in the bearing surface of the crankshaft.

- (1) Unscrew and remove firing mechanism.
- (2) Place a piece of hard wood or a bar of soft copper against outside face of breechblock. Give it a sharp blow with a heavy hammer

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8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 45380

Figure 74—Resizing Primer Seat

and at the same time pull down and out on the operating lever. If this does not loosen the breechblock, place a clean 4- x 4-inch timber through the bore as a rammer to jar the obturator.

(3) When the breech has been opened, examine threads on breechblock and in breech recess. Make necessary repairs as described in subparagraph a (3) above. Scores and bruises on the pressure side of threads can never be removed entirely because of danger of destroying the relation of the surfaces. The removal of metal by filing and polishing must be done lightly; just enough to remove the raised metal and restore the original contour of threads.

f. Repair Bruised Gas-check Seat. Smooth by filing and polishing, using same care as when correcting a similar condition in breech recess and on breechblock.

g. Lubrication. Proper lubrication instructions for lubrication of the breech mechanism are given in section XXV.

BREECH MECHANISM**38. ASSEMBLE BREECH MECHANISM.****a. Assemble Firing Mechanism Safety Plunger Housing Assembly.**

(1) Slide safety plunger spring into hole in end of safety plunger and slide both into position in safety plunger housing (fig. 72).

(2) Put thin film of COMPOUND, rust-preventive, light, on plunger handle threads. Secure safety plunger and spring in place by screwing safety plunger handle into plunger through slot in front face of safety plunger housing.

(3) Install detent spring and detent in safety plunger housing.

(4) Lubricate assembly thoroughly with OIL, engine (seasonal grade).

b. Assemble Firing Mechanism Receiver Housing Assembly (fig. 71).

(1) Place percussion hammer locking pin spring on percussion hammer locking pin. Insert both in position in firing mechanism receiver housing, with end of locking pin protruding from the housing.

(2) Slide percussion hammer locking pin knob in position on protruding end of locking pin. Secure with a $\frac{1}{8}$ - x $\frac{7}{8}$ -inch straight pin. Peen both ends of straight pin.

(3) Place percussion hammer in position, and lightly tap percussion hammer pin into receiver housing and percussion hammer. Secure with a $\frac{3}{16}$ - x $1\frac{1}{8}$ -inch straight pin. Peen both ends of straight pin.

(4) Lubricate assembly thoroughly with OIL, engine (seasonal grade).

c. Assemble Roller to Breechblock.

(1) Lubricate breechblock roller axis pin with OIL, engine (seasonal grade), and insert through breechblock roller. Slide roller and roller axis pin into position on breechblock.

(2) Secure in place with $\frac{5}{32}$ - x $2\frac{1}{4}$ -inch split cotter pin.

d. Assemble Breechblock Operating Lever, Bearing, and Crankshaft (fig. 69).

(1) Place operating lever catch spring in position in operating lever catch. Then insert spring end of operating lever catch spring block in other end of spring. Compress spring, and seat block in catch.

(2) Insert operating lever catch, spring and block in place in operating lever. Secure in position with retaining pin.

(3) Slide operating lever bearing in position on lever, follow with crankshaft, and secure bearing and crankshaft to lever with crankshaft nut and a $\frac{3}{8}$ -16NC-3 x $\frac{1}{2}$ inch long, cup-point, socket-head set screw (figs. 68 and 69).

(4) Lubricate assembly thoroughly with OIL, engine (seasonal grade).

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8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

e. Assemble Breechblock Carrier (fig. 67).

NOTE: Should any of the following be removed from the breechblock carrier for replacement, replace as follows:

(1) **BREECHBLOCK CARRIER KEY.** Place a thin coat of **COMPOUND**, rust-preventive, light, on new key surfaces that contact carrier. Drive key into place in breechblock carrier. Secure key with a $\frac{3}{16}$ - x 1½-inch straight pin. Peen both ends of pin.

(2) **OPERATING LEVER CATCH PLATE.** Coat rear face of new operating lever catch plate and threads of retaining screw with **COMPOUND**, rust-preventive, light. Tap plate into position in carrier, and secure with operating lever catch plate screw.

(3) **BREECHBLOCK CARRIER RETAINER RING.** Coat outside surface of carrier retainer ring with **COMPOUND**, rust-preventive, light, and tap ring into place in carrier. Secure with four carrier retainer ring screws.

f. Install Breechblock Carrier.

(1) Lubricate breechblock carrier bearing washer with **OIL**, engine (seasonal grade), and place in position on top of lower carrier lug of breech ring.

(2) Lift breechblock carrier assembly and push it into position in between carrier lugs of breech ring. Do not push bearing washer off the lower lug.

(3) Line up hinge pinholes in carrier, washer, and carrier lugs of breech ring.

(4) Lubricate entire surface of hinge pin body with **OIL**, engine (seasonal grade). Line up hinge pin keyway with key in carrier, and insert hinge pin down through breech ring, carrier and bearing washer.

(5) Insert a $\frac{7}{32}$ - x 2¼-inch split cotter pin through hinge pin below lower carrier lug of breech ring (fig. 63).

g. Install Operating Lever Assembly.

(1) Lubricate outside surface of operating lever bearing and bearing opening in breechblock carrier with **OIL**, engine (seasonal grade).

(2) Slide operating lever assembly into opening in breechblock carrier, and swing carrier to open position.

(3) Lubricate crankshaft and crosshead, and slide crosshead into position on crankshaft, flat side of crosshead toward crankshaft. Push operating lever all the way into position.

(4) Lubricate body of breechblock operating lever bearing retaining bolt, and push bolt into position in carrier and operating lever. Secure with $\frac{1}{8}$ - x 1¾-inch split cotter pin.

NOTE: Subparagraphs h and i below are to be performed with the breechblock carrier in the open position. Closing the breech before these steps are performed may result in improper assembly or injury to components.

BREECH MECHANISM

h. Install Breechblock Assembly.

(1) Place a wood pole through breechblock and, with two men lifting, insert end of pole in carrier. Then push breechblock from pole onto carrier pintle.

(2) Rotate operating lever to a position which will allow crosshead to enter grooved lug on rear of breechblock. Then slide breechblock all the way into position on carrier pintle, and withdraw wood pole.

(3) Place breechblock control arc in position, and secure with two screws (fig. 66).

i. Install Obturator Spindle Group and Firing Mechanism Receiver Housing Assembly.

(1) Place a light film of OIL, engine (seasonal grade), all over obturator spindle spring. Slide obturator spindle spring A12921 into place in breechblock carrier.

(2) Place, in the following order, obturator front split ring, gas-check pad, rear split ring, inner ring and filling-in disk on stem of obturator spindle (fig. 70).

(3) Insert threaded end of obturator spindle assembly through spindle opening of breechblock and carrier.

(4) Insert firing mechanism receiver assembly in place in carrier. Then pressing inward on the receiver housing to compress the obturator spindle spring, screw the receiver assembly on the obturator spindle.

(5) Make sure gas-check pad and split rings are in proper position, concentric with spindle.

(6) Screw receiver housing assembly onto the obturator spindle as far as it will go (approximately seven full turns).

CAUTION: Excessive headspace between firing mechanism and obturator spindle plug B241 will cause blowback of the primer. Hence, it is essential that firing mechanism receiver housing assembly be screwed onto the obturator spindle approximately seven full turns. After the firing mechanism safety plunger housing is installed, the receiver housing can be backed off the obturator spindle (subpar. k below).

j. Install Firing Mechanism Safety Plunger Housing Assembly.

(1) While retaining the lock detent and detent spring in position, fasten the safety housing lock to safety plunger housing by screwing in the housing lock screw behind the housing lock screw washer.

(2) Turn housing lock so housing can be placed in its recess in carrier. Slip the left end through flanges of breechblock carrier retainer ring.

(3) Rotate lock 90 degrees to secure housing in position. Detent will now be in the notch in the lock.

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8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

(4) Screw $\frac{3}{8}$ -inch flat-head machine screw into place through right end of housing, into carrier.

k. Headspace Adjustment. Back off the firing mechanism receiver housing assembly *slightly* to the *nearest* position where the slot in the housing will aline with the firing mechanism safety plunger to allow the safety plunger to enter the slot freely.

l. Connect Counterbalance (par. 66 of TM 9-335 or par. 49 of TM 9-350).

Section X

HOWITZER (OR GUN) BARREL

	Paragraph
General	39
Maintenance and repair of barrel	40

39. GENERAL.

a. Procedure for removing and mounting the howitzer or gun barrel is covered in paragraphs 26 and 119 of this manual.

40. MAINTENANCE AND REPAIR OF BARREL.

a. General.

(1) Clean barrel assembly thoroughly with SOLVENT, dry-cleaning.

(2) Examine barrel assembly as outlined in paragraphs 13, 14, and 15.

b. **Bruised Breech Recess Threads.** Remove scoring or bruises on breech recess threads with breech thread file B141012 (fig. 73) and polish with CLOTH, crocus. CAUTION: Remove only enough metal to eliminate score or bruise.

c. Bruised Rail Bearing Strips.

(1) Check the bronze bearing strips, which are riveted to the longitudinal rails on which the barrel slides in recoil and counterrecoil, for scores and bruises. If not scored, bruised, or damaged beyond repair, remove scores and burs with a flat scraper or smooth file. Remove only enough metal to level the surface. Polish with CLOTH, crocus (fig. 75).

(2) Always clean bearing strips with SOLVENT, dry-cleaning, after scraping and polishing. Otherwise, small particles of metal will act as an abrasive when barrel is in operation.

(3) Report badly damaged bearing strips or rails to the Chief of Ordnance.

d. Damaged Dust Cover Strip.

(1) Straighten a bent dust guard strip (fig. 75) by removing it from the barrel assembly and bumping out dents on a flat metal surface with a hammer.

(2) Replace a badly damaged dust guard strip with a new one.

e. Damaged Leveling Plates.

(1) Leveling plates A12121 in top surface of breech ring are sometimes damaged by accident. Correct by filing or scraping as follows:

(a) Place master level rest or parallel straightedge in muzzle end of tube on lower side of bore.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

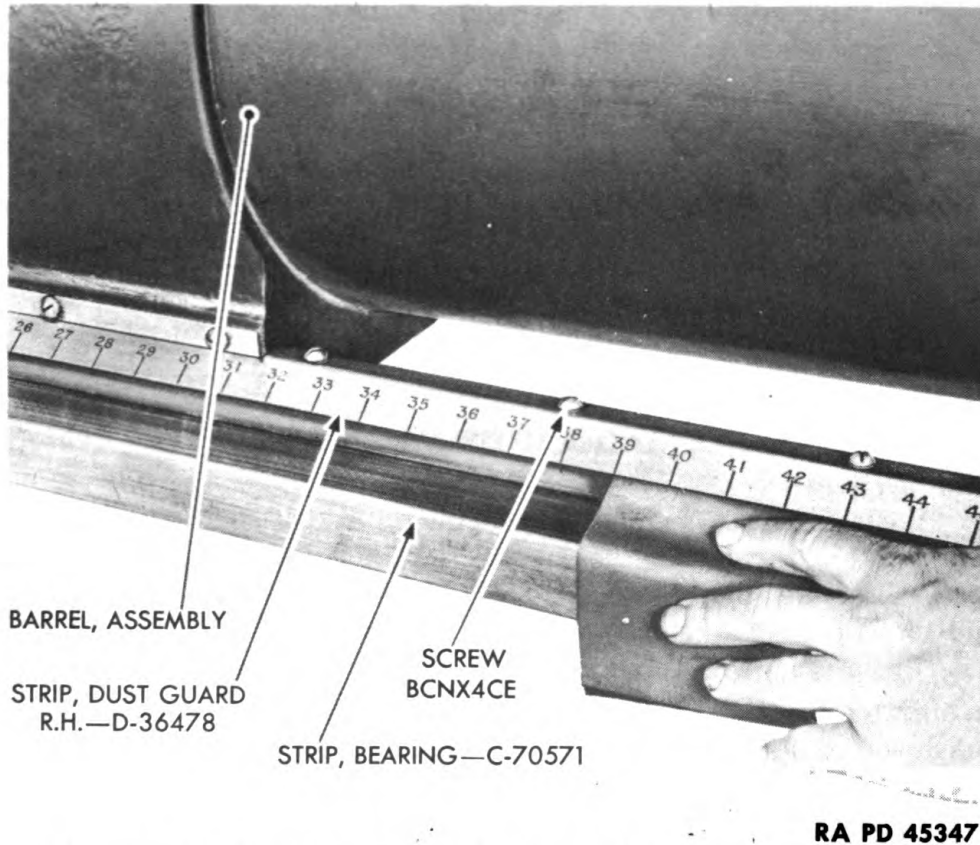


Figure 75—Repairing Bruised Bearing Strip (8-in. Howitzer)

(b) Place master level or gunner's quadrant on protruding end of master level rest or parallel straightedge; then bring the barrel exactly level.

(c) Transfer master level or gunner's quadrant to the leveling plates and remove metal by filing and polishing from the leveling plate toward which the bubble moves until bubble is exactly centered.

(2) A flat, true surface or face plate large enough to cover both leveling plates, coated with blue marking paint (**PRUSSIAN BLUE**) or **LEAD**, white, should be used to detect high spots and to ensure that entire surface of each leveling plate is true, and that the plates are true with each other.

f. Damaged Breechblock Rotating Cam.

(1) A badly worn or damaged breechblock rotating cam must be replaced with a new one.

(2) Remove screws A25314 and A25317, and pull rotating cam C3730 from its socket in breech ring (fig. 62).

(3) Coat screws and rotating cam surfaces which fit into breech ring with **COMPOUND**, rust-preventive, light, and install new cam.

Section XI

COUNTERBALANCE

	Paragraph
General	41
Disassemble counterbalance	42
Maintenance and repair of counterbalance	43
Assemble counterbalance	44

41. GENERAL.

a. Information covering the description and operation of the counterbalance assembly is contained in paragraph 9, TM 9-335 or paragraph 7, TM 9-350.

b. Removal and assembly of the counterbalance assembly are described in paragraphs 65 a and 66, TM 9-335 and paragraphs 48 and 49, TM 9-350.

42. DISASSEMBLE COUNTERBALANCE.

a. Remove counterbalance assembly from breech ring (par. 65 a, TM 9-335 or par. 48, TM 9-350).

b. Disassemble Counterbalance.

(1) Place counterbalance assembly in a vise equipped with copper jaws. Remove counterbalance piston rod by unscrewing it from the counterbalance piston (fig. 76).

(2) Screw improvised extractor (par. 24) into counterbalance piston as far as it will go. Tighten extractor nut and washer up against rear head B8483 (fig. 77).

(3) Remove screw A25313, and unscrew and remove front head B8484 from counterbalance cylinder (fig. 78).

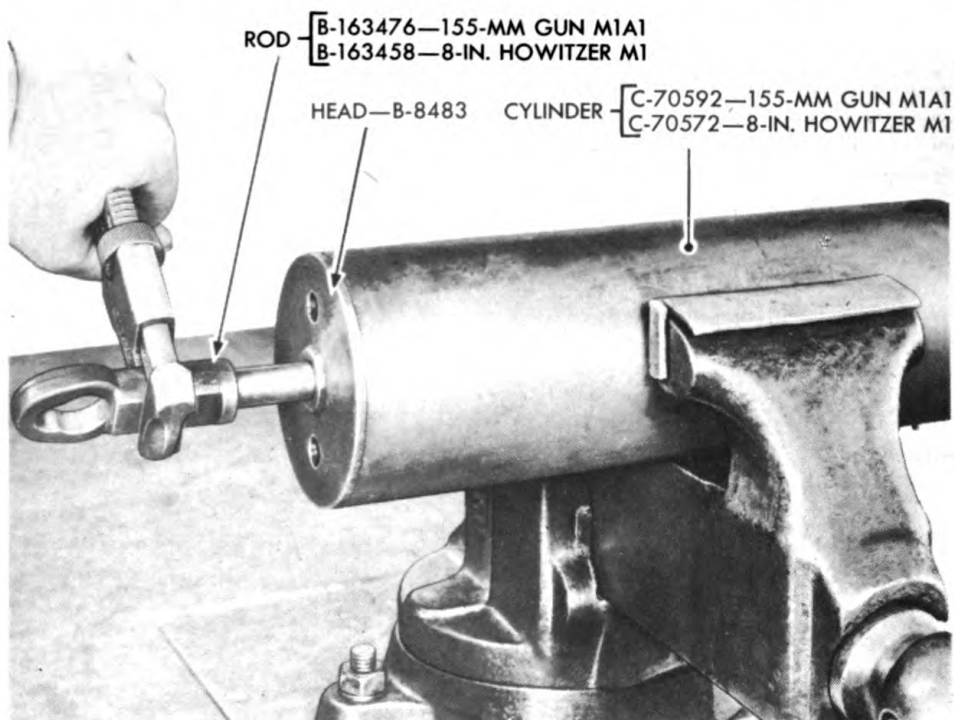
(4) Unscrew nut on extractor rod and release all compression from spring C70427 (fig. 79). **CAUTION:** Do not unscrew extractor rod from counterbalance piston as piston and spring will fly out with great force.

(5) After extractor nut is backed off from extractor rod to the point where all compression is off the counterbalance spring, unscrew and remove piston B163455 and pull spring C70427 the rest of the way out of the counterbalance cylinder.

(6) Pull extractor rod, nut, and washer from rear head B8483. Remove screw A25313. Unscrew and remove head B8483 from counterbalance cylinder with face spanner wrench B168043.

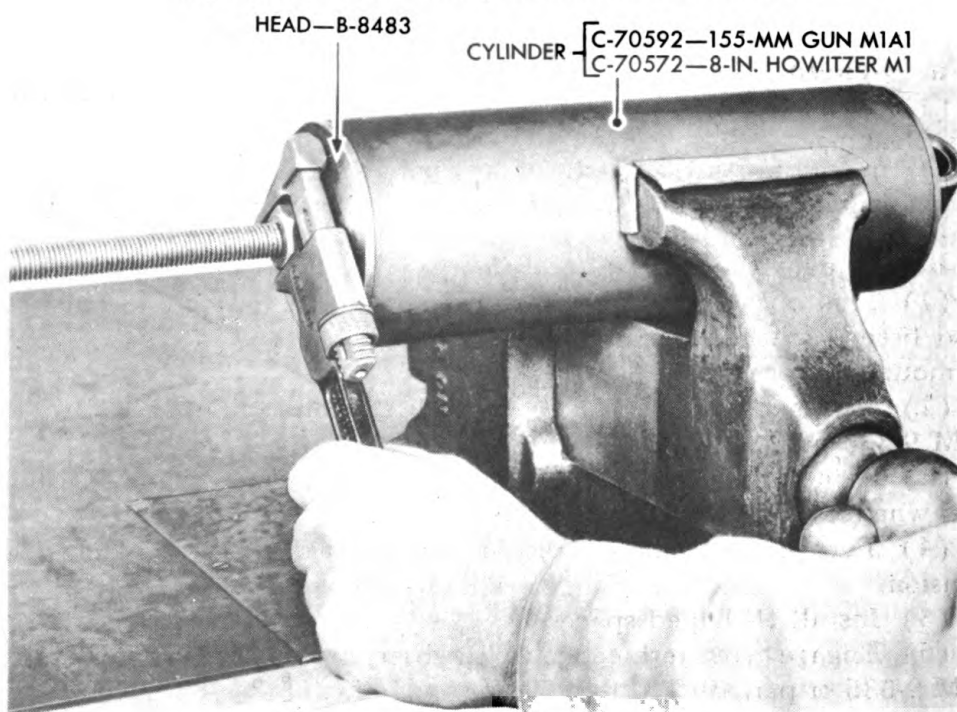
(7) The counterbalance assembly is now completely disassembled (fig. 80).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



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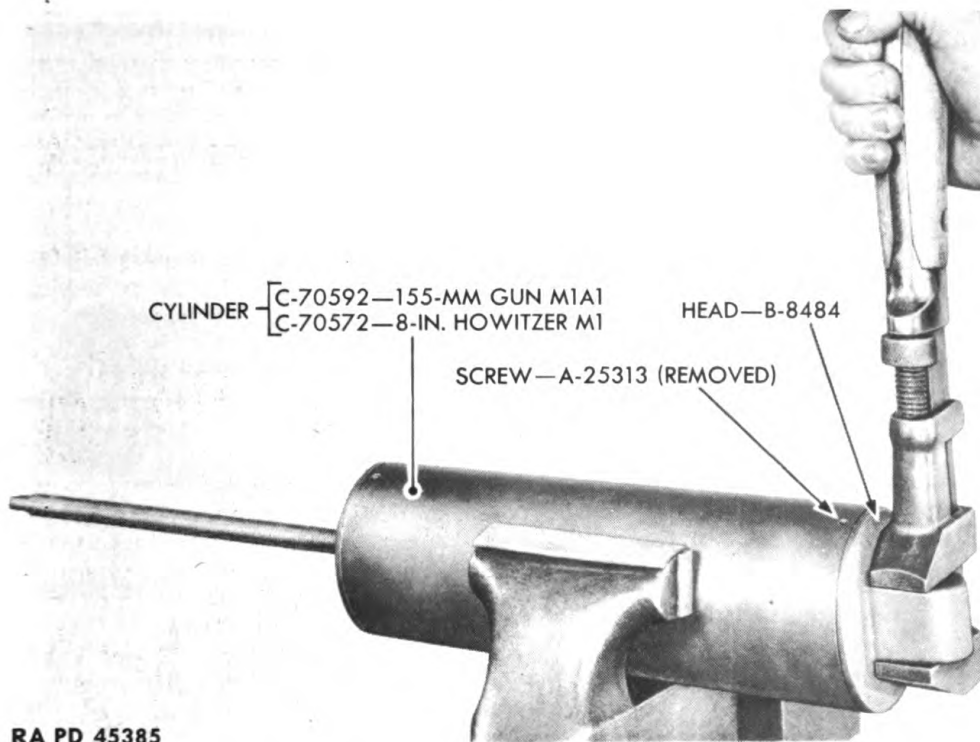
Figure 76—Removing Counterbalance Rod



RA PD 45386

Figure 77—Installing Counterbalance Spring Extractor

COUNTERBALANCE



RA PD 45385

Figure 78—Removing Counterbalance Cylinder Front Head

43. MAINTENANCE AND REPAIR OF COUNTERBALANCE.

a. General.

- (1) Clean all parts of counterbalance thoroughly in SOLVENT, dry-cleaning.
- (2) Examine all parts carefully for wear or breakage.
- (3) Replace worn or damaged parts.

b. Adjust Counterbalance Spring Tension.

- (1) This operation must be performed when the counterbalance and breech mechanisms are assembled to the barrel, and the barrel is mounted on carriage.
- (2) Disengage counterbalance from breech mechanism (par. 65 a, TM 9-335 or par. 48, TM 9-350).
- (3) Remove U-shaped spacer installed on counterbalance piston rod when disengaging the counterbalance.
- (4) Turn counterbalance piston rod in or out to obtain desired tension.
- (5) Install U-shaped spacer.
- (6) Engage counterbalance with breech mechanism (par. 66, TM 9-335 or par. 49, TM 9-350).
- (7) Test operation by opening and closing breech mechanism, with barrel at different degrees of elevation.

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

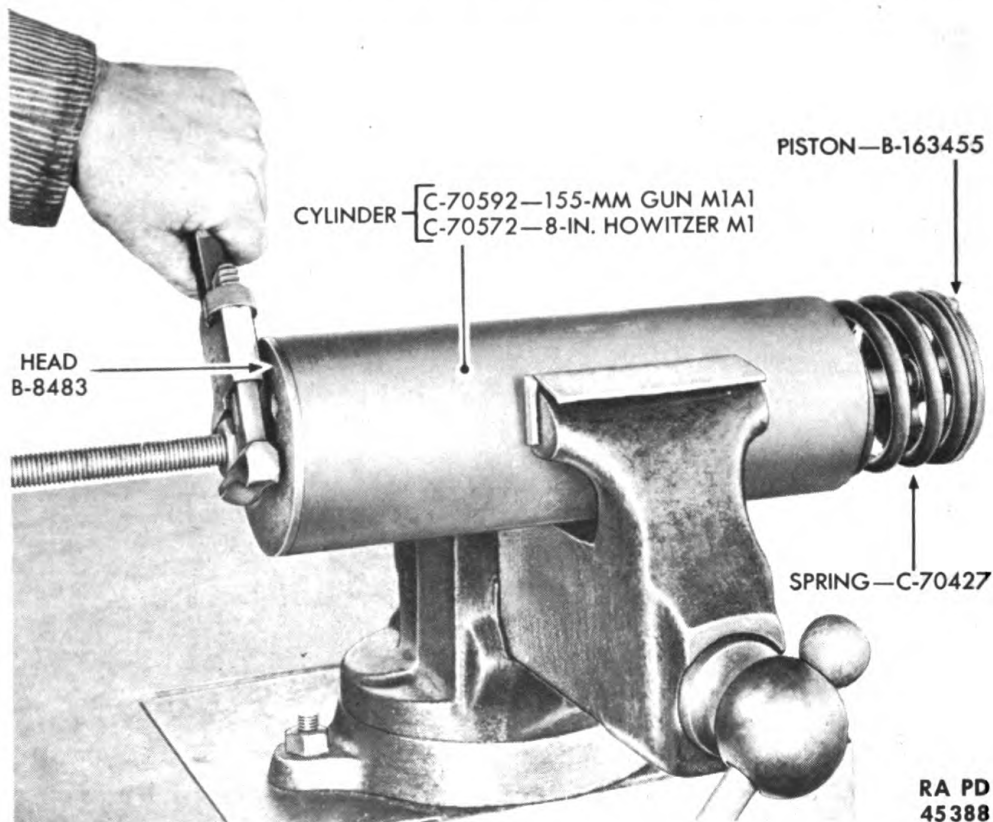


Figure 79—Releasing Counterbalance Spring

NOTE: Some early 155-mm guns are equipped with a regulating device as an extension of the hinge pin. By rotating the counterbalance regulating screw, the tension of the counterbalance spring may be adjusted to suit the angle of elevation.

44. ASSEMBLE COUNTERBALANCE.

a. Assemble Counterbalance.

(1) Coat inside of counterbalance cylinder, piston rod (threaded

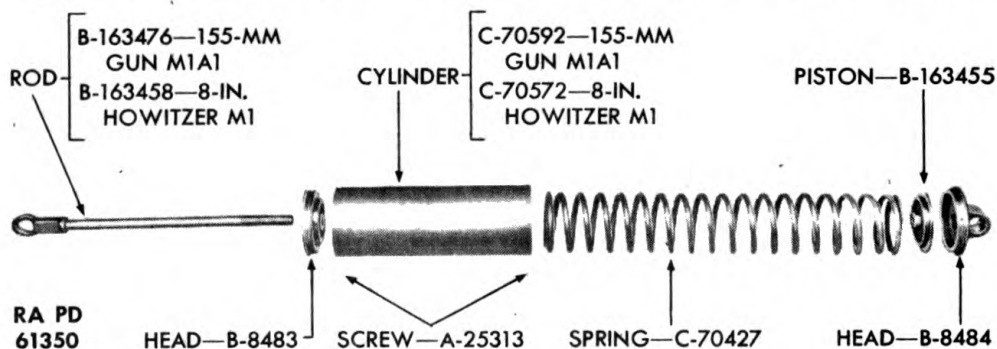


Figure 80—Counterbalance—Exploded View

COUNTERBALANCE

end), head threads, and piston with COMPOUND, rust-preventive, light, before assembling counterbalance.

(2) Place counterbalance cylinder in a vise fitted with copper jaws. Screw counterbalance cylinder rear head into place with face spanner wrench B168043. Secure with headless set screw.

(3) Insert counterbalance spring in counterbalance cylinder. Screw improvised extractor rod into counterbalance piston. NOTE: Screw piston on the rod end having the short thread. Insert rod through spring and rear head.

(4) Place extractor rod washer on rod up against counterbalance rear head; then screw extractor rod nut up against rod washer. Tighten nut and draw spring and piston into counterbalance cylinder (fig. 79). NOTE: Line up lug or key on piston with slot on inside of cylinder.

(5) Draw spring and piston in far enough to permit installation of counterbalance cylinder front head. Screw front head into place, and secure with headless set screw (fig. 78).

(6) Unscrew and remove extractor rod, nut, and washer (fig. 77). Then screw counterbalance piston rod into counterbalance piston (fig. 76).

b. Mount counterbalance on breech ring (par. 66, TM 9-335 or par. 49, TM 9-350).

Section XII

EQUILIBRATORS

General	Paragraph 45
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45. GENERAL.

a. Information pertaining to the operation and purpose of the equilibrators is contained in paragraphs 14, 41, 54, and 70, TM 9-335 and in paragraphs 14, 30, and 39, TM 9-350.

b. Additional information on checking equilibrators for nitrogen pressure and for pressure leakage is contained in paragraph 19 of this manual.

c. Removal and installation of equilibrators are covered in paragraphs 27 and 118 of this manual.

d. Disassembly, repair, and assembly of equilibrators require special facilities available at an arsenal or base repair shop. Because of complicated construction and danger due to high nitrogen pressure present in the mechanism, disassembly of interior parts of equilibrators is forbidden.

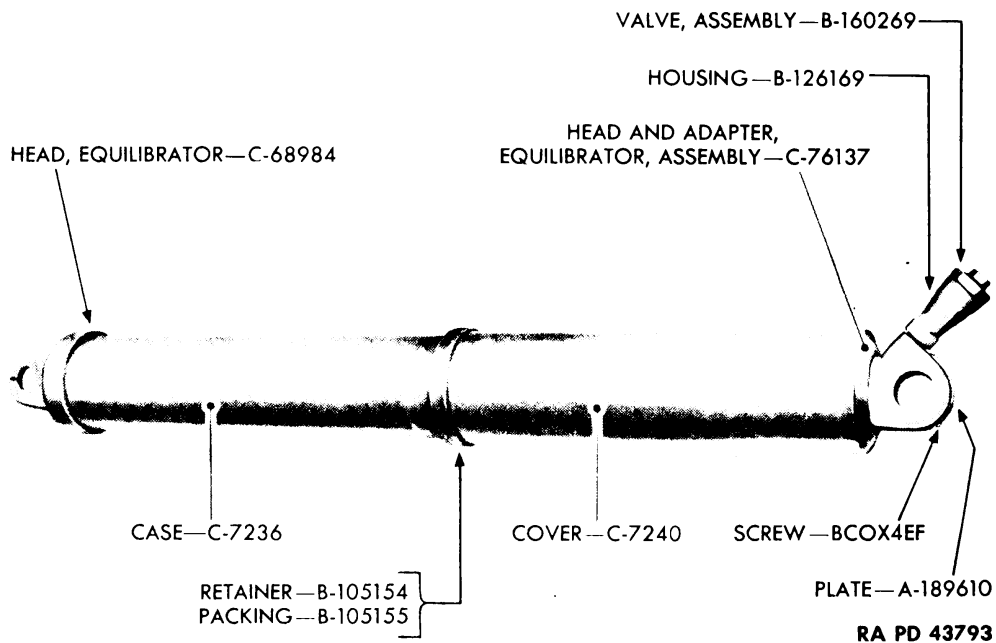


Figure 81—Equibrator Assembly

Section XIII

TRUNNION BEARING CAP GROUPS

	Paragraph
General	46
Disassemble trunnion bearing cap group	47
Maintenance and repair of trunnion bearing cap group	48
Assemble trunnion bearing cap group	49

46. GENERAL.

a. The trunnion bearing cap groups, right and left, each consist of a trunnion bearing cap assembly and trunnion bearing group. The trunnion bearing cap assembly is a large steel casting to which the trunnion bearing group, the equilibrator guide mechanism, and equilibrator temperature scale are assembled (figs. 82 and 83).

b. The trunnion bearing cap groups, right and left, comprise the pivoting mechanism for elevating and depressing the cradle and barrel assemblies and for temperature adjustment of the equilibrators to insure proper functioning.

c. When the recoil mechanism was removed from the carriage (par. 29), the trunnion bearing cap mechanisms remained attached to the cradle trunnions.

d. When properly lubricated, negligible maintenance is required for these mechanisms. In cases where it is necessary to remove and disassemble them, proceed as outlined in the next paragraph.

47. DISASSEMBLE TRUNNION BEARING CAP GROUP.

a. Remove Trunnion Bearing Group.

(1) Using special spanner wrench C7360 (fig. 84), unscrew and remove trunnion bearing closure cap B105201.

(2) Straighten and remove the locking lug on washer B105091 from slot in nut B105093 (fig. 85).

(3) Using special spanner wrench B105516, remove nut B105093 and washer B105091 (fig. 86). If necessary, tap end of wrench with hammer to break nut loose.

(4) Screw the extracting sleeve nut B109110 (fig. 20) on sleeve B105094 and tighten nut with brass drift and hammer to extract sleeve (fig. 87).

(5) While one man lifts on trunnion bearing cap, another should pull out on extracting sleeve nut to remove the sleeve (fig. 88).

(6) Lift trunnion bearing cap and remove it from cradle trunnion pin.

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

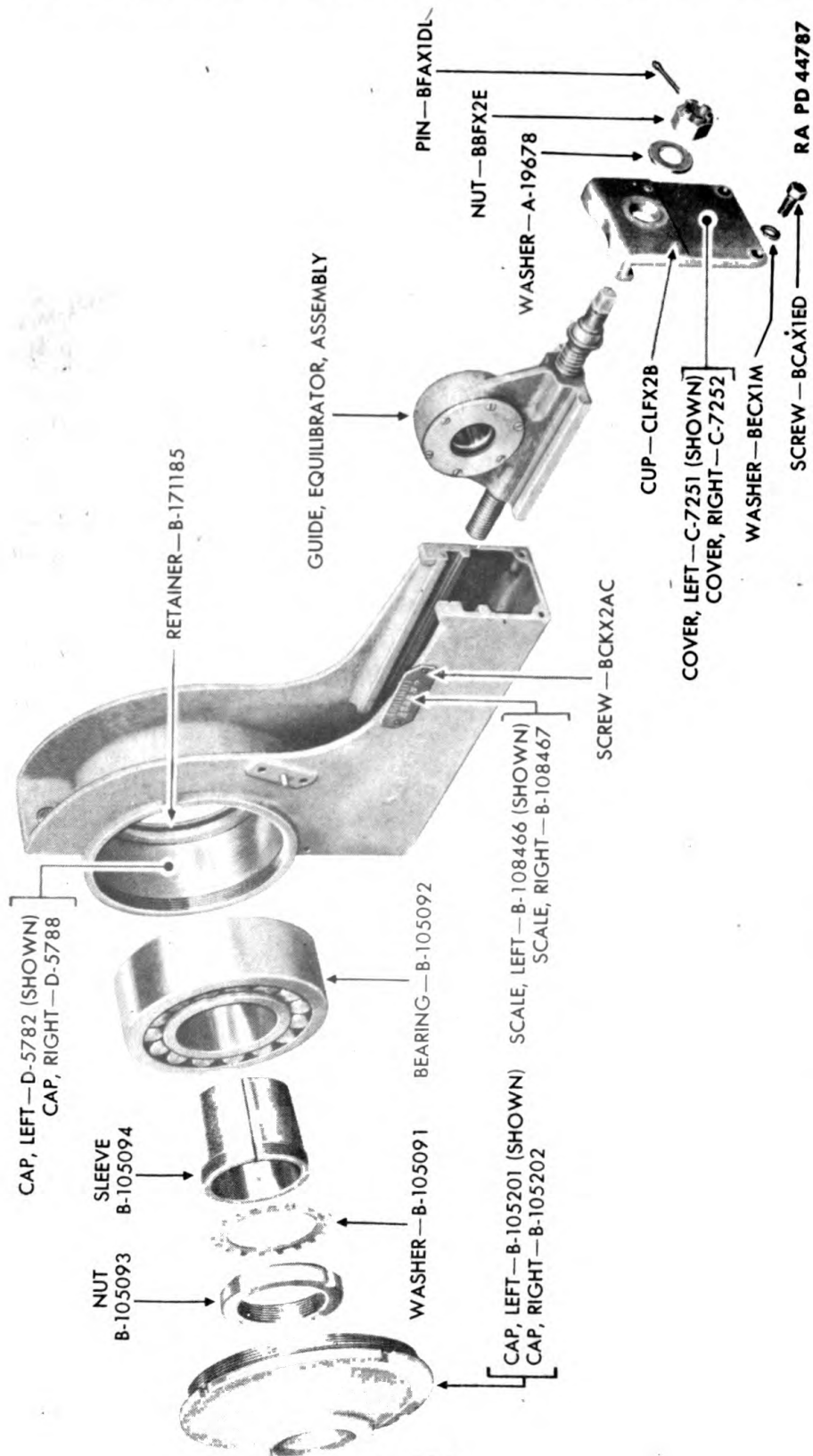


Figure 82—Trunnion Bearing Cap—Exploded View

TRUNNION BEARING CAP GROUPS

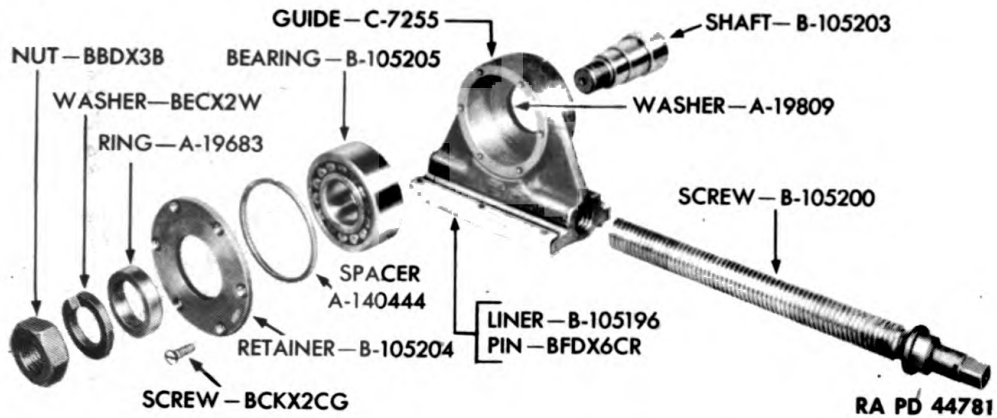


Figure 83—Equilibrator Guide—Exploded View

b. Disassemble Trunnion Bearing Cap.

(1) Place the trunnion bearing cap, shoulder side up, on two wood blocks. Tap the roller bearing B105092 from trunnion bearing cap D5782 (fig. 89).

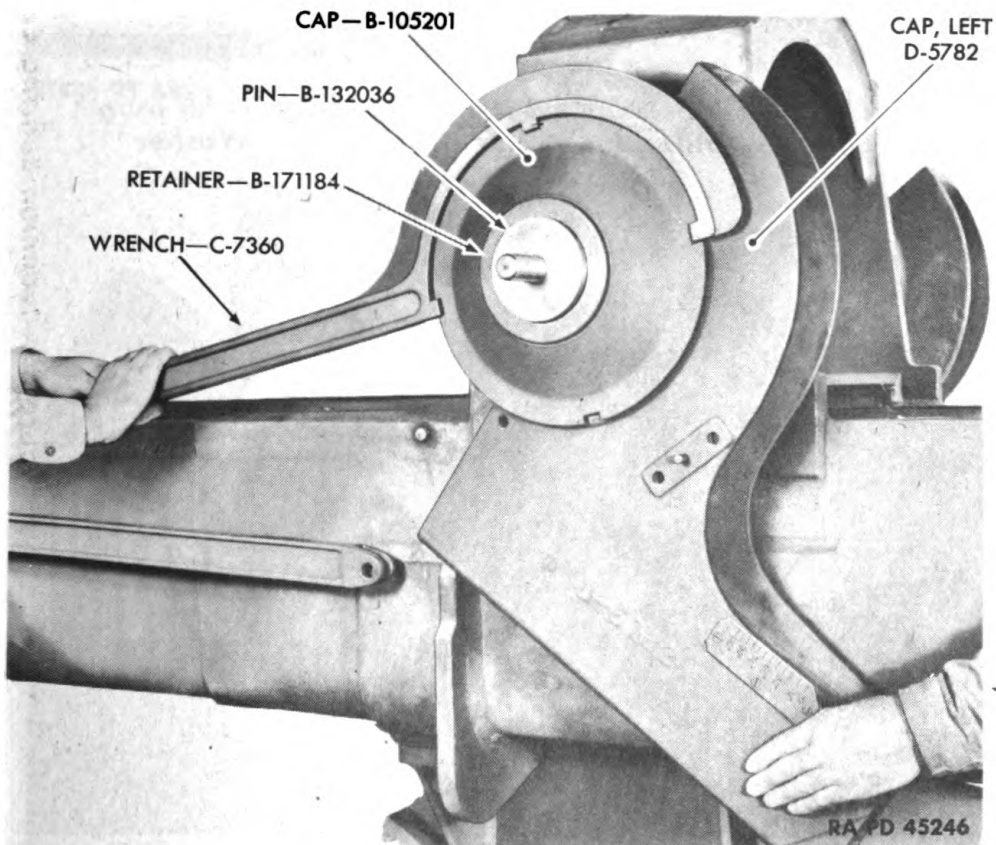
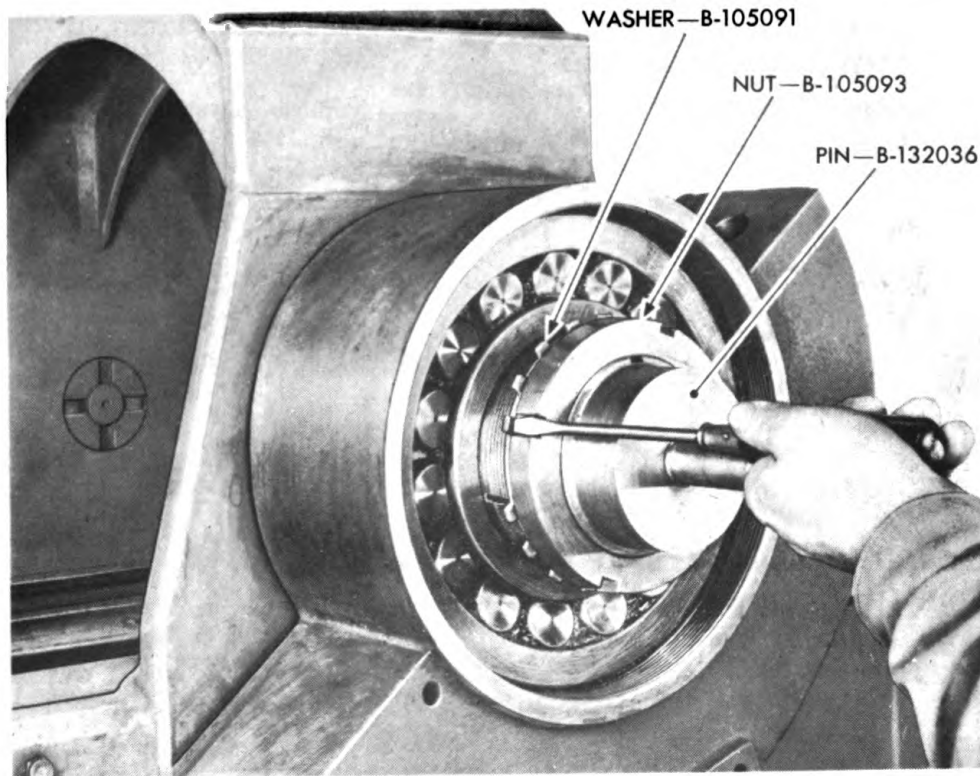


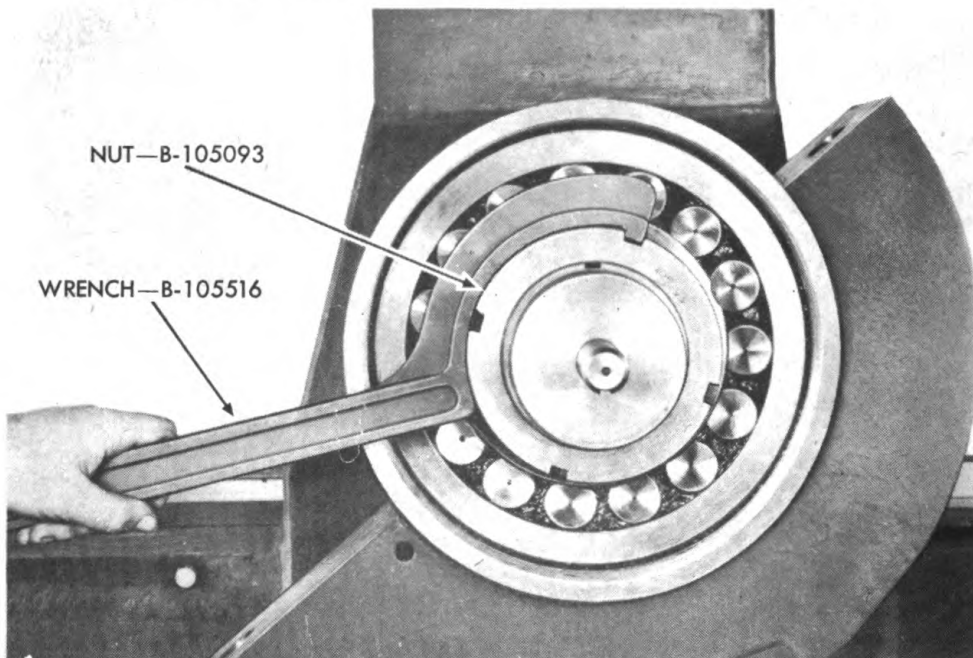
Figure 84—Removing Trunnion Bearing Closure Cap

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



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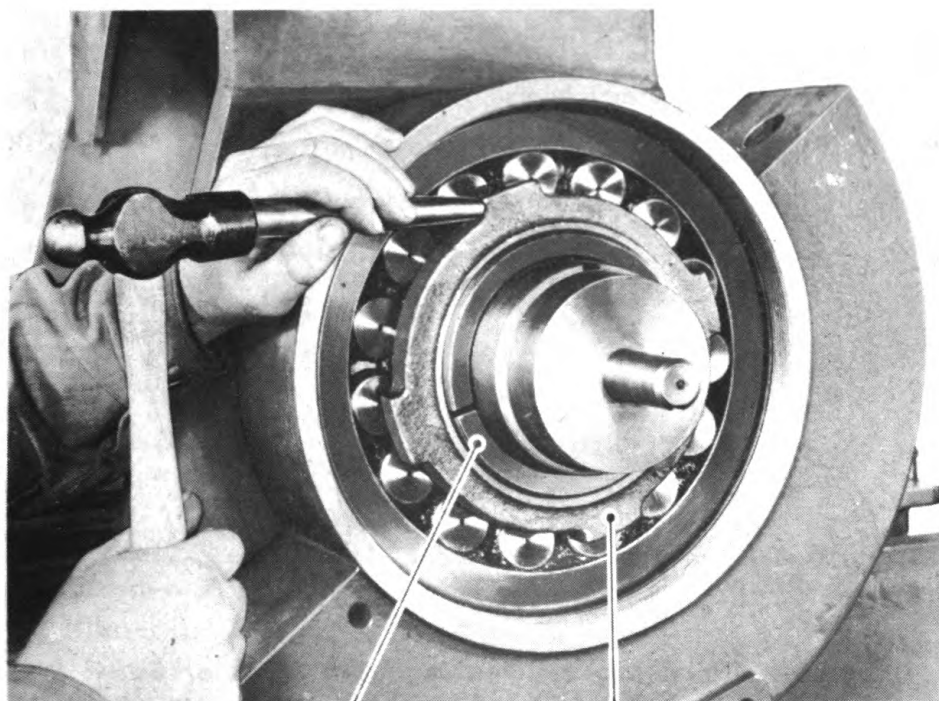
Figure 85—Unlocking Roller Bearing Lock Washer



RA PD 45207

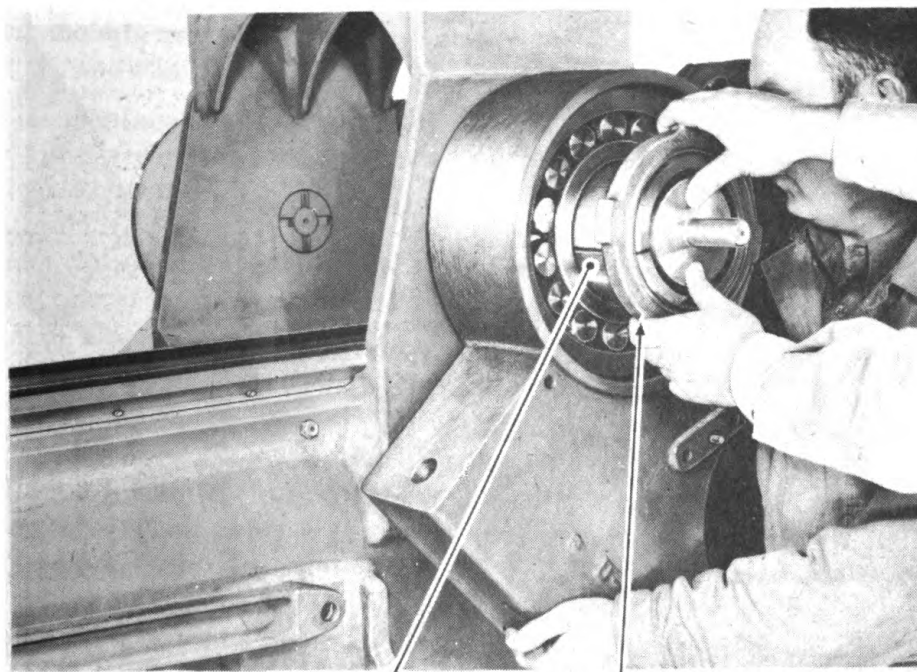
Figure 86—Removing Lock Nut

TRUNNION BEARING CAP GROUPS



SLEEVE—B-105094 NUT (TOOL)—B-109110 RA PD 45020

Figure 87—Loosening Removable Bearing Mounting Sleeve



SLEEVE—B-105094 NUT (TOOL)—B-109110 RA PD 45211

Figure 88—Removing Removable Bearing Mounting Sleeve

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

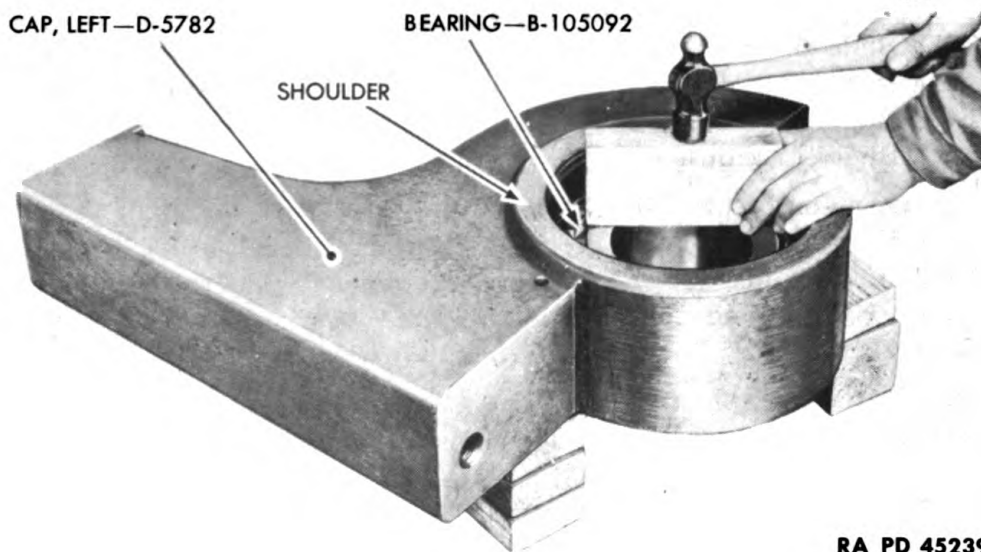


Figure 89—Removing Bearing from Trunnion Cap

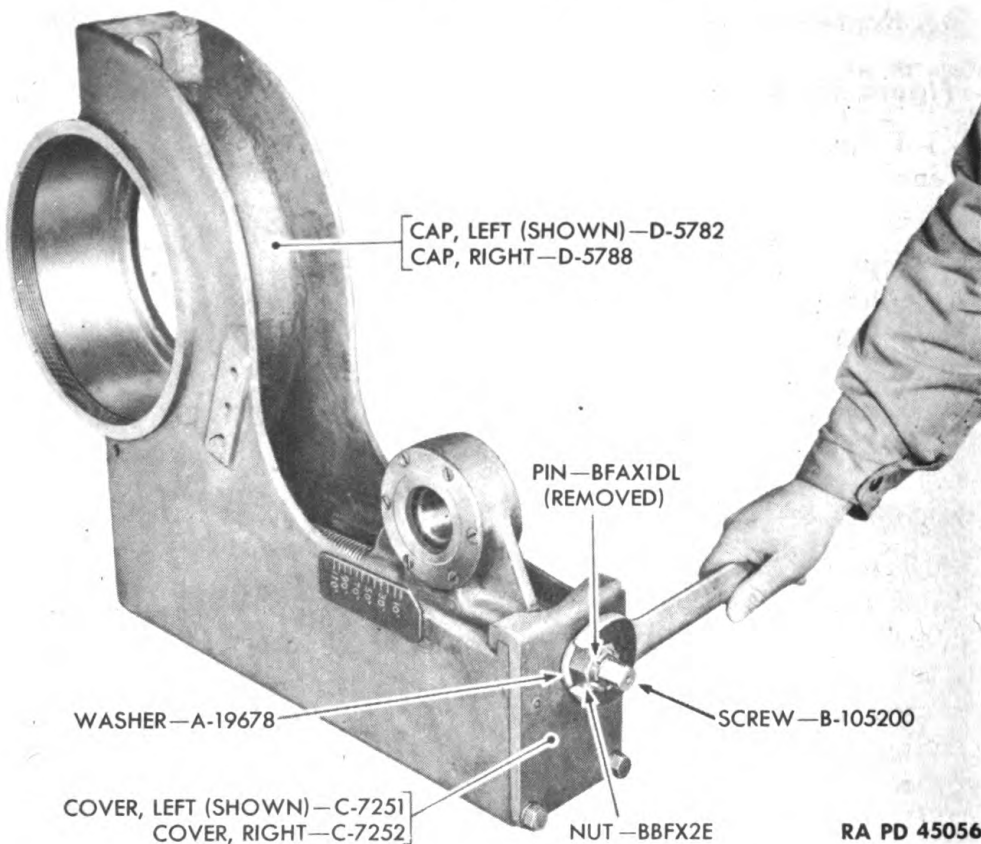


Figure 90—Removing Equilibrator Guide Adjusting Screw Nut

TRUNNION BEARING CAP GROUPS

(2) Remove cotter pin BFAX1DL, nut BBFX2E, and washer A19678 from screw B105200 (fig. 90).

(3) Slide the screw and guide back in bearing cap so screw is out of cover C7251. Then remove screws BCAX1ED and washers BECX1M, and lift cover off.

(4) Slide equilibrator guide assembly from trunnion bearing cap.

c. Disassemble Equilibrator Guide.

(1) Remove six screws BCKX2CG from roller bearing retainer B105204 and guide C7255, and remove retainer (fig. 83).

(2) Push bearing spacer A140444 and bearing B105205 from guide C7255, and unscrew screw B105200 from guide.

d. To disassemble the other trunnion bearing cap group, repeat operations as described in subparagraphs a, b, and c above.

48. MAINTENANCE AND REPAIR OF TRUNNION BEARING CAP GROUP.

a. General.

(1) Clean all parts thoroughly in SOLVENT, dry-cleaning.

(2) Examine all parts for wear or breakage.

(3) Replace worn or damaged parts.

b. Repair Scored or Bruised Equilibrator Guide Liner.

(1) Place the guide assembly in vise fitted with copper jaws.

(2) Remove burs or scores from liner with smooth file. Remove just enough metal to remove burs (fig. 91). Polish with CLOTH, crocus, and clean with SOLVENT, dry-cleaning.

c. Replace Badly Damaged Equilibrator Liner.

(1) Place guide assembly in vise fitted with copper jaws.

(2) Drive pins BFDX6CR from liner B105196 and tap liner off guide C7255.

(3) Replace liner with new one. Secure with $\frac{1}{8}$ - x 1-inch straight brass pins. Rivet over both ends of pins and file ends flush with surface of liner. Polish with CLOTH, crocus. Clean with SOLVENT, dry-cleaning.

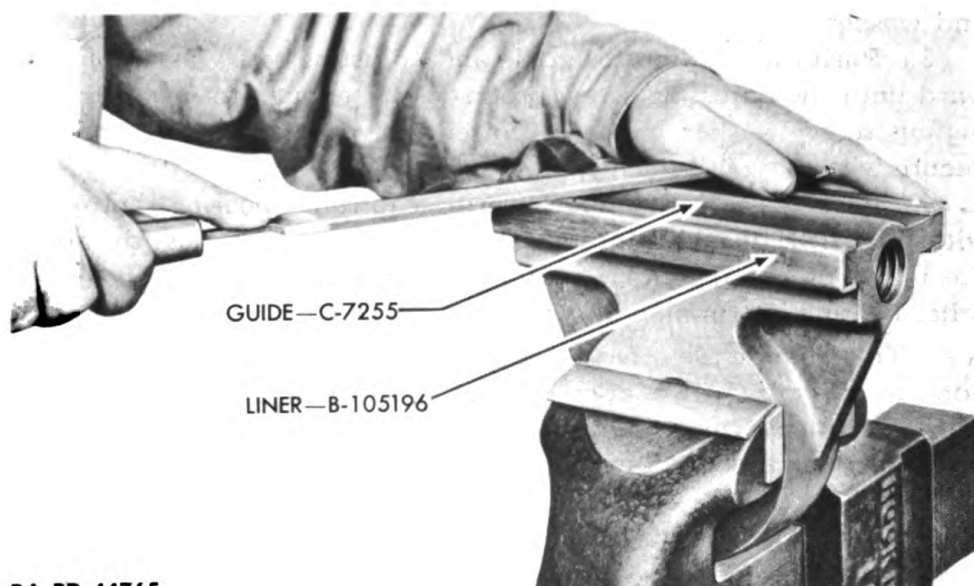
d. Repair a Burred Roller Bearing Roller.

(1) Remove a large trunnion cap roller bearing roller from bearing B105092 by lining up the roller to be removed with the notch in the inner race. Then swing inner race and roller assembly part way out of outer race. Pry cage away from roller. Roller will come out freely. Do not pry hard enough to spring cage.

(2) Remove bur from roller with smooth file and polish with CLOTH, crocus. Clean with SOLVENT, dry-cleaning.

(3) Slide the roller back into position in cage. Pry lightly between cage and roller to permit roller to enter all the way.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44765

Figure 91—Repairing Equilibrator Guide Liner

NOTE: Rollers are not replaceable items. If damaged to the extent that smooth operation is impossible, the entire bearing must be replaced.

49. ASSEMBLE TRUNNION BEARING CAP GROUP.

a. Assemble Equilibrator Guide (fig. 83).

(1) Pack the equilibrator shaft connecting roller bearing thoroughly with **GREASE**, general purpose (seasonal grade). Grease the inside bearing surface of equilibrator guide and insert the roller bearing in the guide. Follow with roller bearing spacer.

(2) Coat threads of equilibrator guide adjusting screw lightly with **GREASE**, general purpose (seasonal grade). Run screw in place in equilibrator guide.

(3) Coat mating surfaces of roller bearing retainer and equilibrator guide and the threads of the six retaining screws with **COMPOUND**, rust-preventive, light. Assemble retainer to guide.

b. Assemble Trunnion Bearing Cap.

(1) Lubricate equilibrator guide liners and guide slides of trunnion bearing cap with **OIL**, engine (seasonal grade). Slide equilibrator guide assembly in place in bearing cap. **NOTE:** The guide assembly must be inserted in the bearing cap with the roller bearing retainer toward the side of the cap on which the temperature adjustment scale is mounted.

(2) Coat mating surfaces of trunnion bearing cap cover, the bearing cap, and threads of cover retaining screws with **COMPOUND**, rust-

TRUNNION BEARING CAP GROUPS

preventive, light. Attach cover to cap with the two retaining screws and washers.

(3) Push the equilibrator guide and adjusting screw assembly outward until the adjusting screw protrudes far enough to install the adjusting screw washer, nut and cotter pin. Install washer and nut. Secure with $\frac{1}{8}$ - x $1\frac{3}{4}$ -inch split cotter pin (fig. 90).

(4) Pack the large trunnion bearing cap roller bearing thoroughly with **GREASE**, general purpose (seasonal grade), and lightly grease the inside of bearing cap where the roller bearing fits. Install large roller bearing in trunnion bearing cap (fig. 89).

c. To assemble the other trunnion bearing cap group, repeat operations as described in subparagraphs **a** and **b** above. **NOTE:** The trunnion bearing cap groups are not mounted on the cradle until the cradle is mounted on the carriage (par. 117).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

**Section XIV
RECOIL MECHANISM**

	Paragraph
General	50
Disassemble cradle	51
Disassemble variable recoil mechanism	52
Disassemble replenisher tube	53
Disassemble replenisher	54
Maintenance and repair of cradle	55
Maintenance and repair of recoil mechanism	56
Assemble replenisher	57
Assemble replenisher tube	58
Assemble variable recoil mechanism	59
Assemble cradle	60

50. GENERAL.

a. Disassembly, repair, and assembly of a recoil mechanism of this type can be undertaken only at a repair shop specially equipped for the purpose.

b. High pressures, present in the system at all times, make it extremely dangerous to attempt unauthorized disassembly. *It is forbidden to perform disassembly of the recoil mechanism beyond that outlined in this manual.*

c. Ordnance maintenance personnel may dismount, disassemble, repair or adjust, assemble, and mount any part of the replenisher, the variable recoil mechanism, the counterrecoil cylinder front head, the filling and drain valve housing and parts, and the oil index packing as described herein. *It is absolutely forbidden to remove any other cylinder head or the stuffing boxes. Under no circumstances, attempt to take the mechanism apart.*

d. *All work on the recoil mechanism must be performed by ordnance maintenance personnel under the direction of an officer especially designated for this purpose.*

e. Complete information pertaining to the functioning, operation, care and preservation and malfunctions of the recoil mechanism is contained in TM 9-335 and TM 9-350.

(1) Description and functioning, paragraphs 19 and 20, TM 9-335 or paragraphs 9 and 10, TM 9-350.

(2) Operation, paragraph 29 d, TM 9-335 or paragraph 23 c, TM 9-350.

(3) Care and prevention, paragraphs 39 and 40, TM 9-335 or paragraphs 28 and 29, TM 9-350.

RECOIL MECHANISM

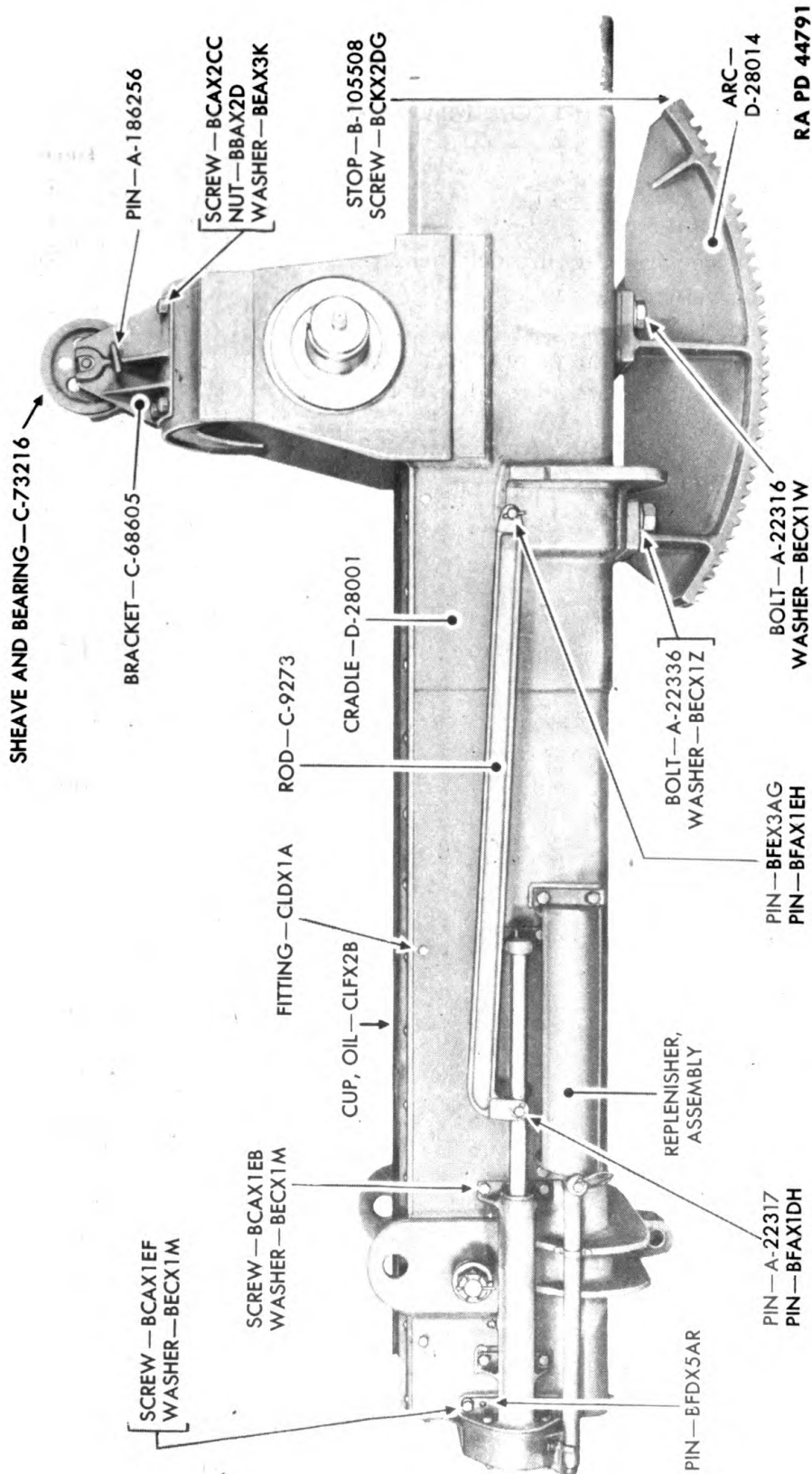
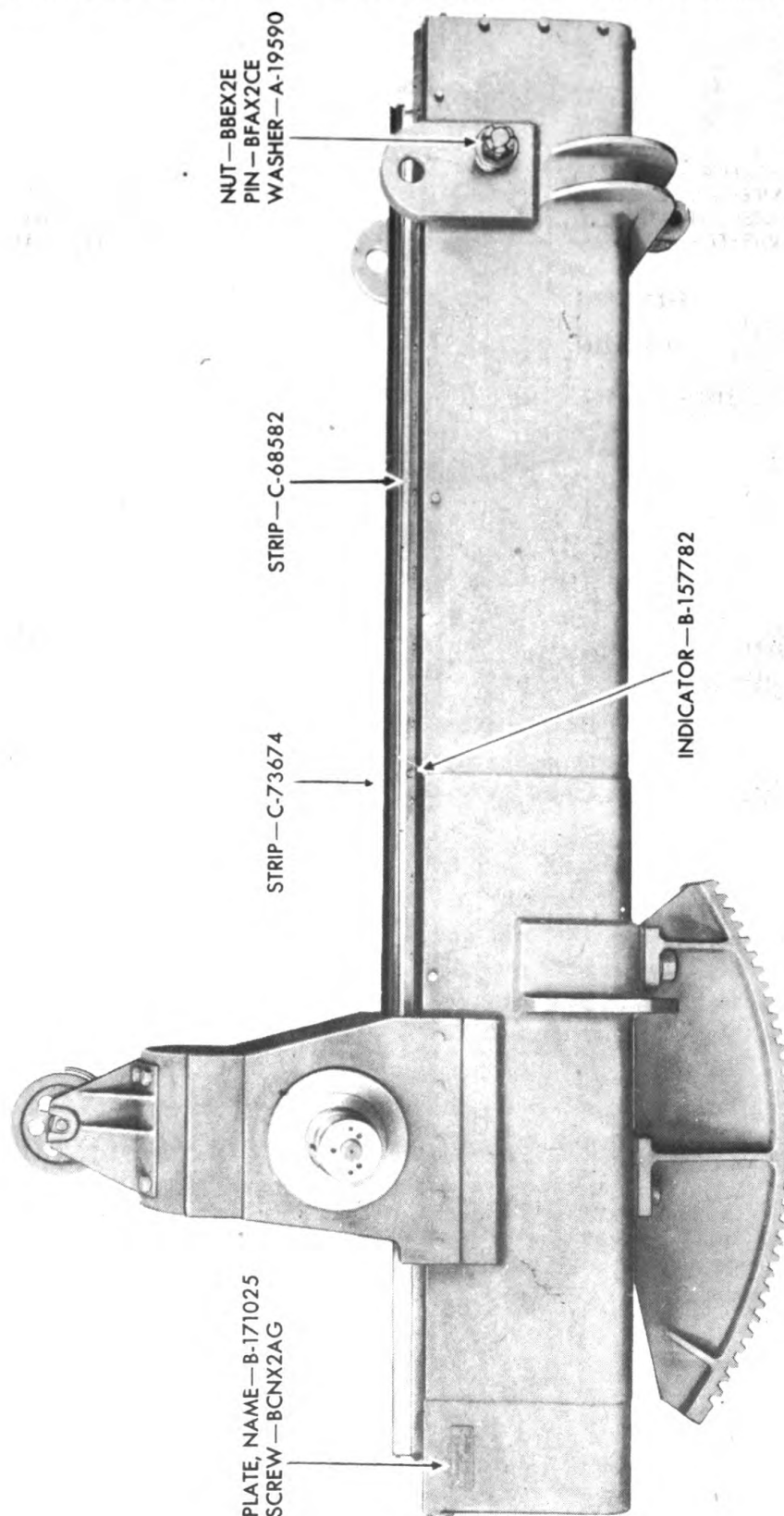


Figure 92 - Recoil Mechanism M4 - Left Side

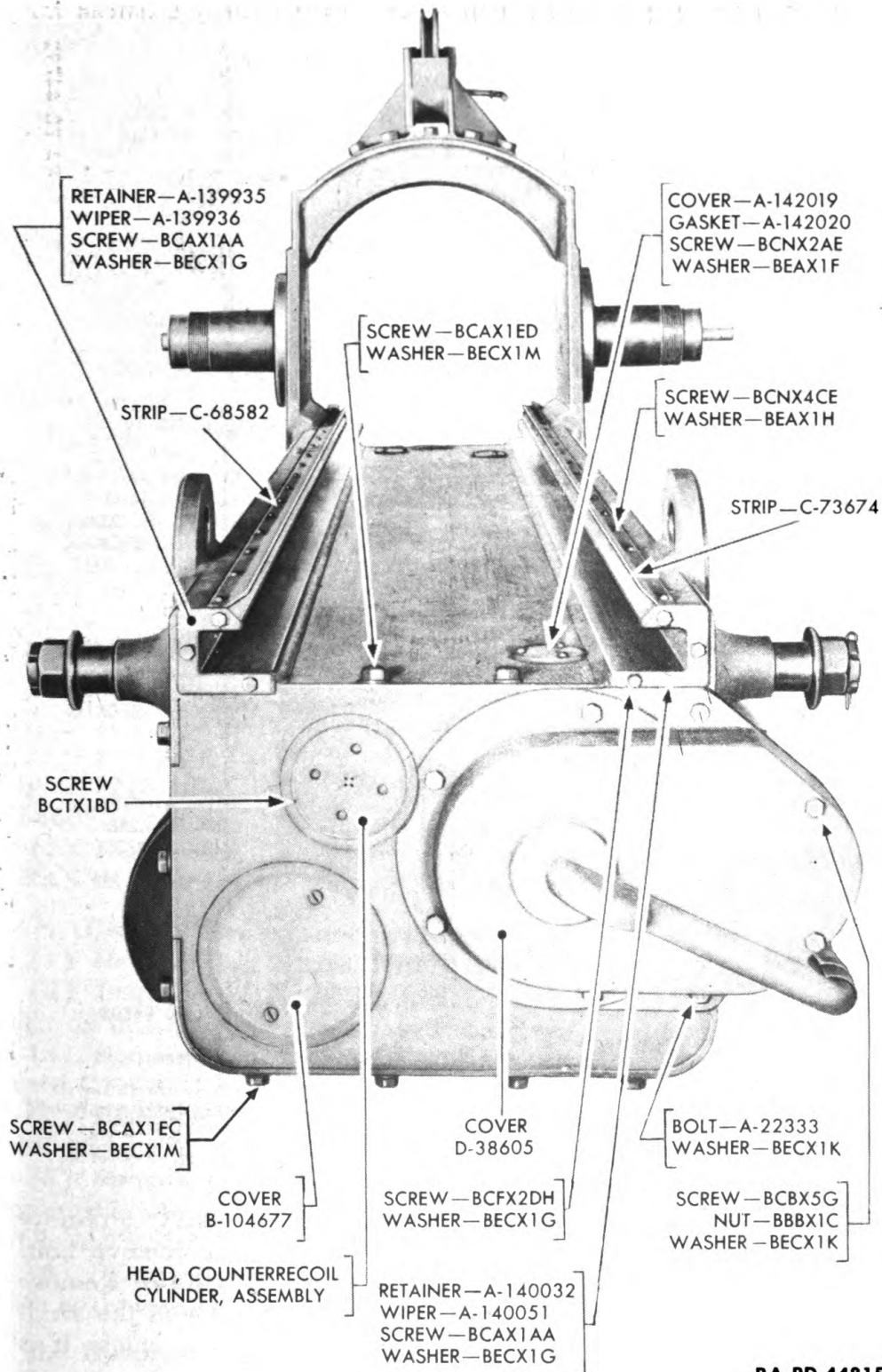
ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 44792

Figure 93—Recoil Mechanism M4—Right Side

RECOIL MECHANISM



RA PD 44815

Figure 94—Recoil Mechanism M4—Front View

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

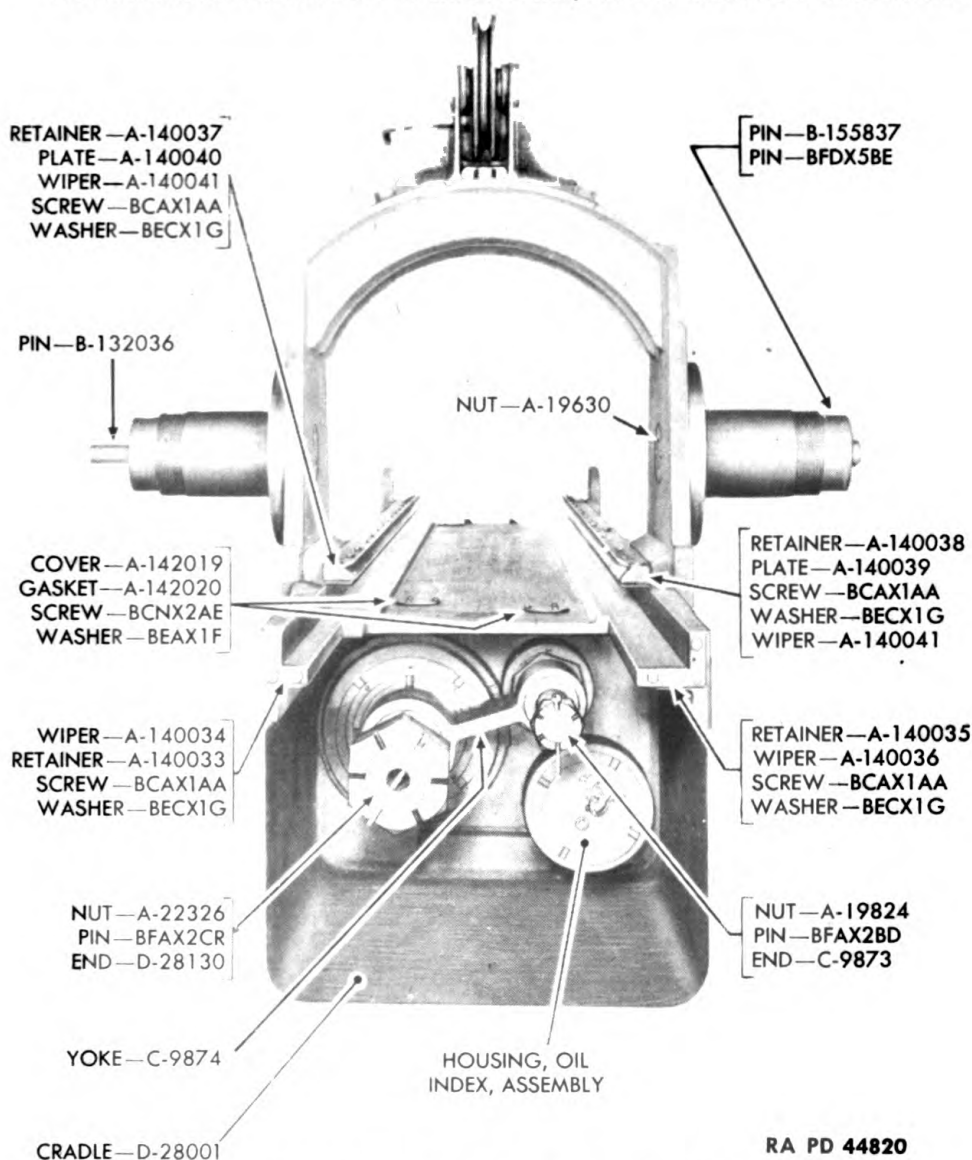


Figure 95—Recoil Mechanism M4—Rear View

(4) Malfunctions, paragraph 57, TM 9-335 or paragraph 41, TM 9-350.

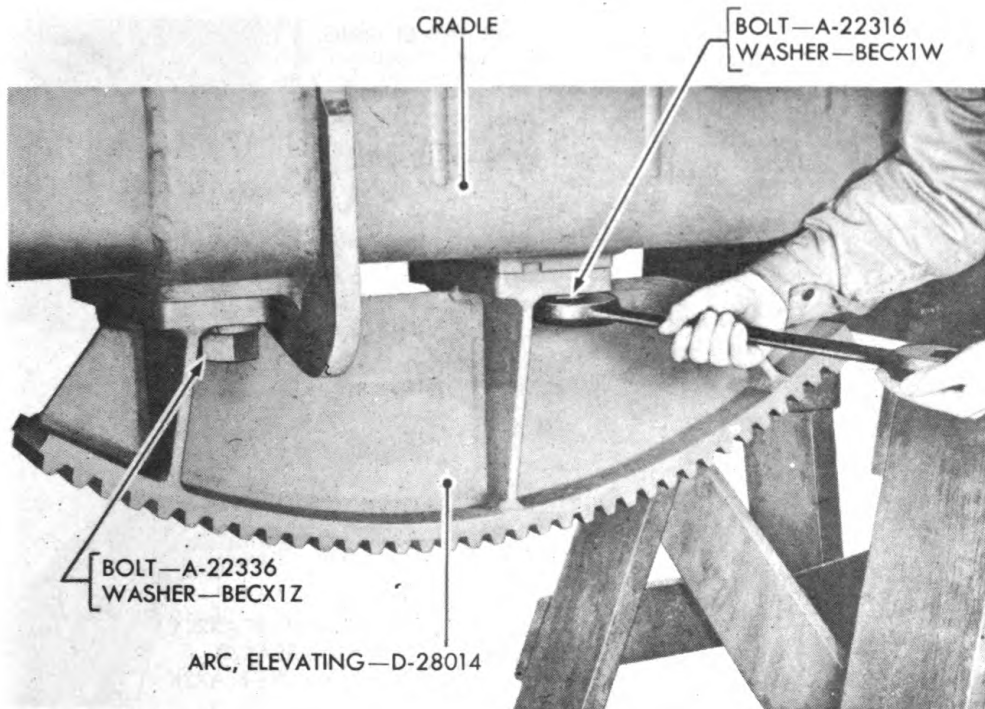
51. DISASSEMBLE CRADLE.

a. **Remove Elevating Arc (fig. 96).** If it is necessary to remove the elevating arc D28014 for repair or replacement, remove bolts A22336 and A22316, and washers BECX1Z and BECX1W. Remove arc. Two men will be needed to perform this operation, as the arc is heavy. **CAUTION:** Do not remove the elevating arc unless it is necessary.

b. Remove Bracket and Sheave.

(1) Pull out on pin A186256 to release sheave and bearing assem-

RECOIL MECHANISM



RA PD 45067

Figure 96—Removing Elevating Arc

bly C73216; then pry sheave and bearing assembly from bracket C68605 to remove the assembly (fig. 97).

(2) Remove eight screws BCAX2CC, nuts BBAX2D, and washers BEAX3K from bracket C68605, and remove bracket.

c. Remove Replenisher Assembly.

(1) Remove plug B155851 from retainer B132062 (fig. 98).

(2) Insert oil release A1001 in valve retainer and drain off replenisher oil into a container. Remove release, and replace plug.

(3) Remove three screws BCBX5A and washers BEAX1H from guard C72622. Remove guard (fig. 99).

(4) Disconnect connector A172782 and tube B159318 from replenisher (fig. 100).

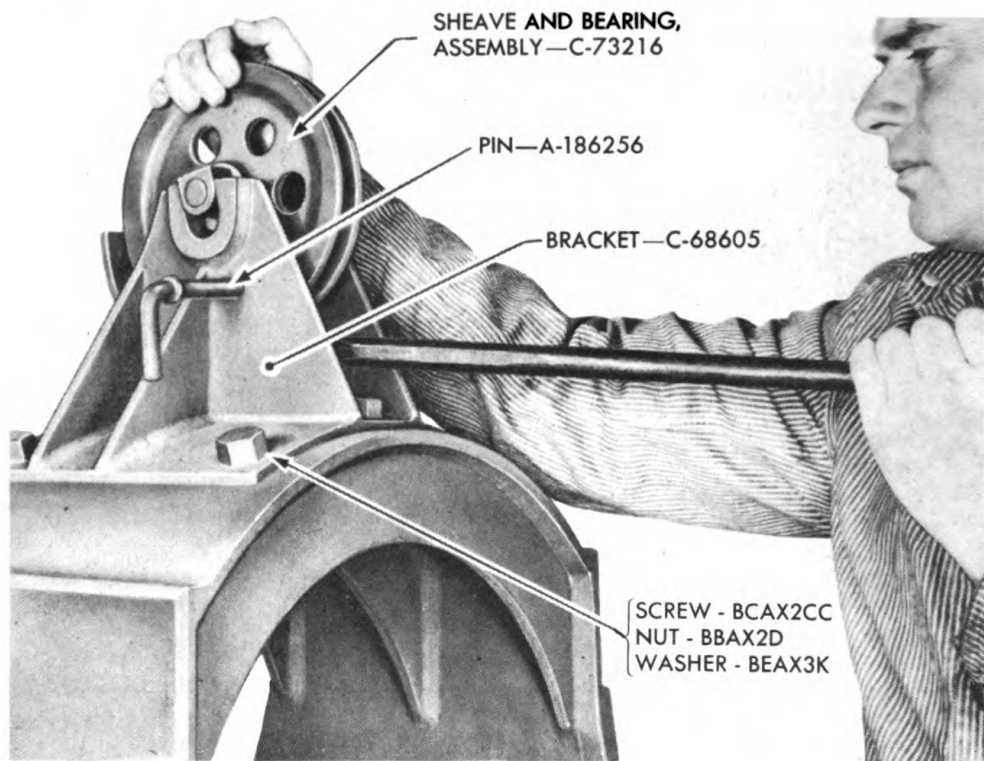
(5) Remove four screws BCBX2BB and washers BEAX2D from replenisher assembly (fig. 98). Have another man steady replenisher while last screw is being removed. Lift replenisher away from cradle.

(6) Plug the end of replenisher tube B159318 with clean cloth as soon as replenisher is removed.

d. Remove Replenisher Tube and Packing Retainer.

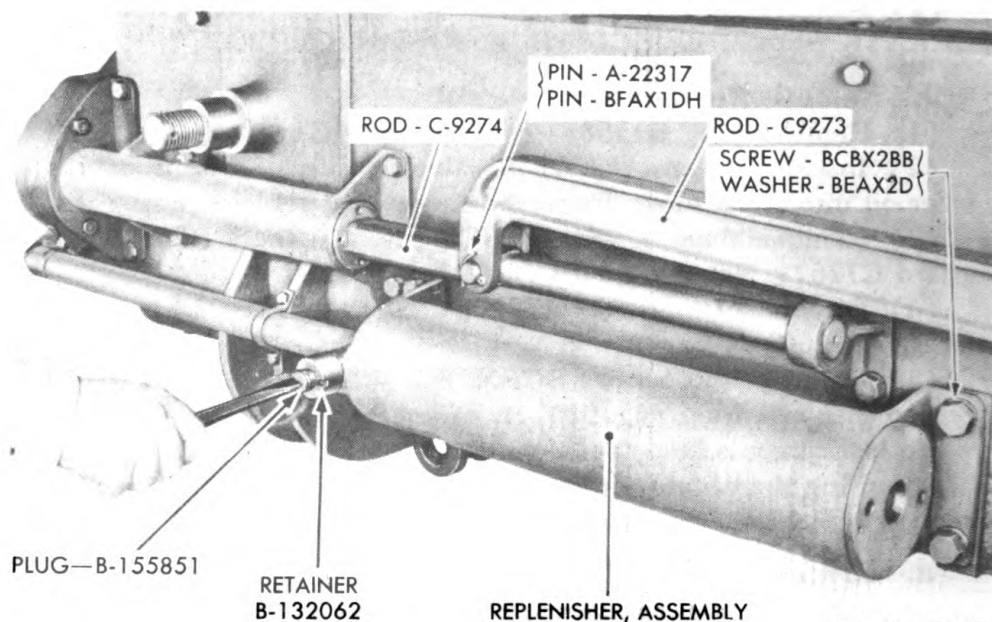
(1) Remove two screws BCBX5G, nuts BBBX1C, and washers BECX1K (fig. 101). Then remove six bolts A22333 and washers BECX1K. Lift off cover D38605.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 73192

Figure 97—Removing Sheave and Bearing Assembly



RA PD 73193

Figure 98—Removing Plug from Replenisher

RECOIL MECHANISM

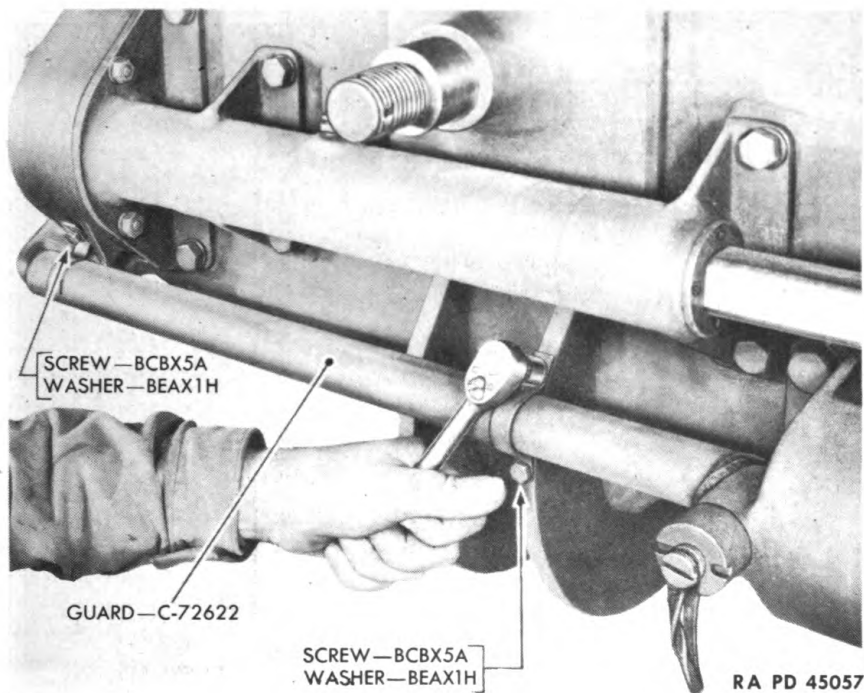


Figure 99—Removing Replenisher Tube Guard

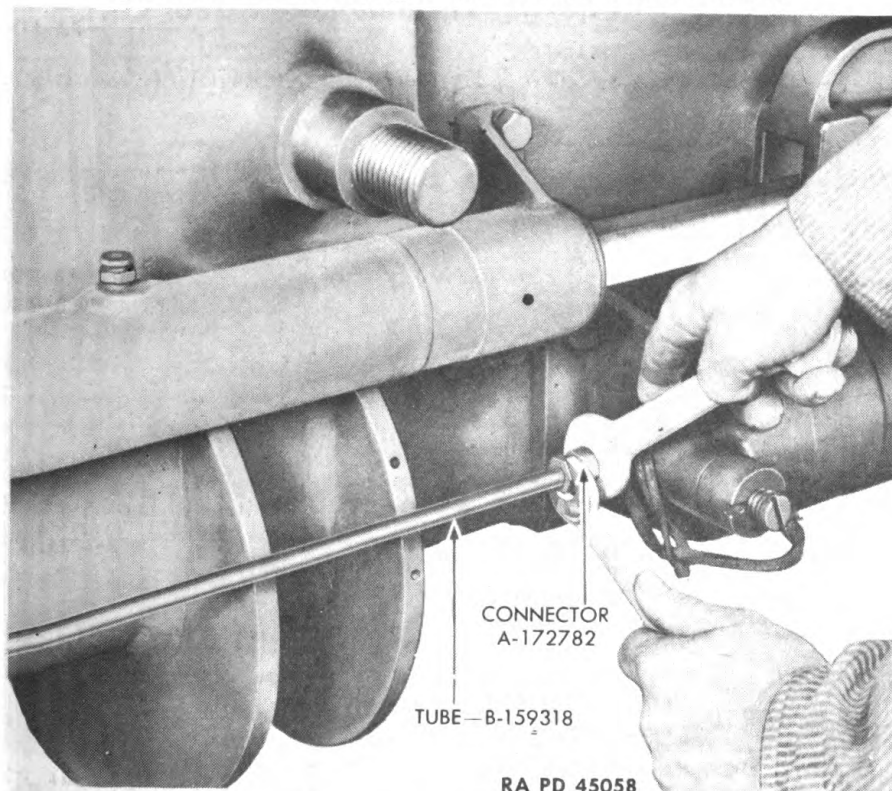
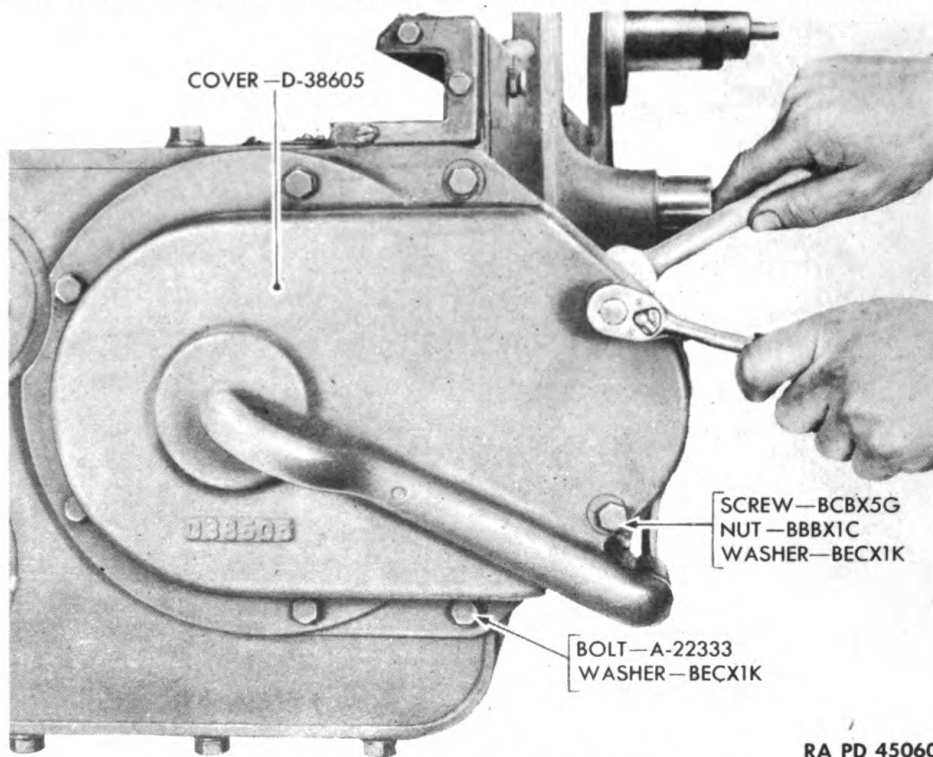


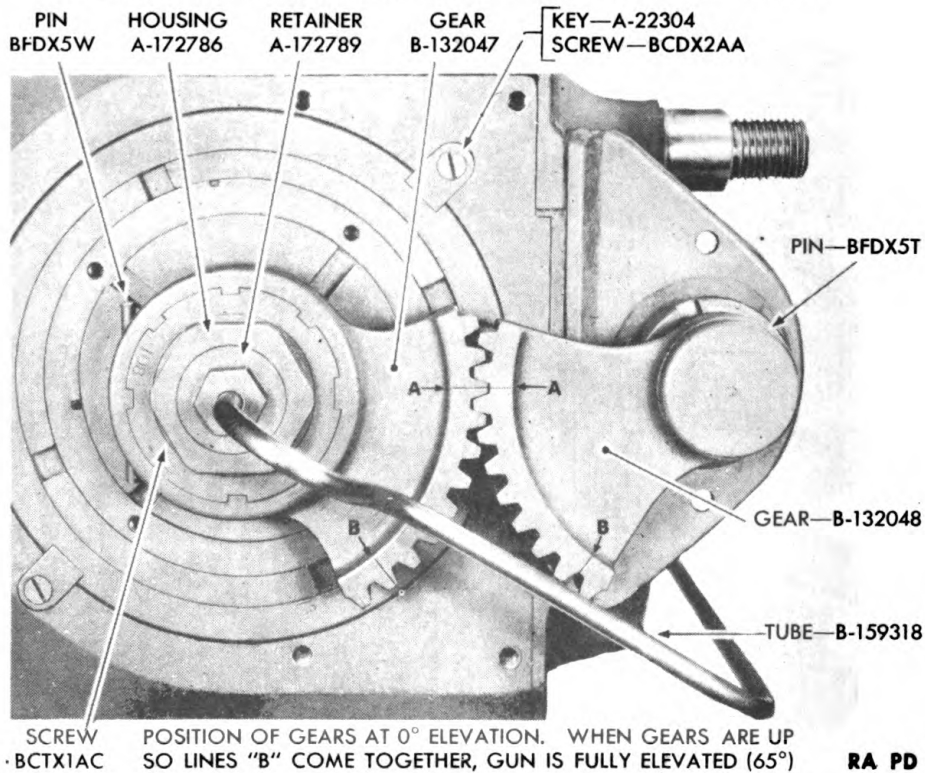
Figure 100—Disconnecting Replenisher Tube

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 45060

Figure 101—Removing Variable Recoil Gear Cover



RA PD 44751

Figure 102—Variable Recoil Gears

RECOIL MECHANISM

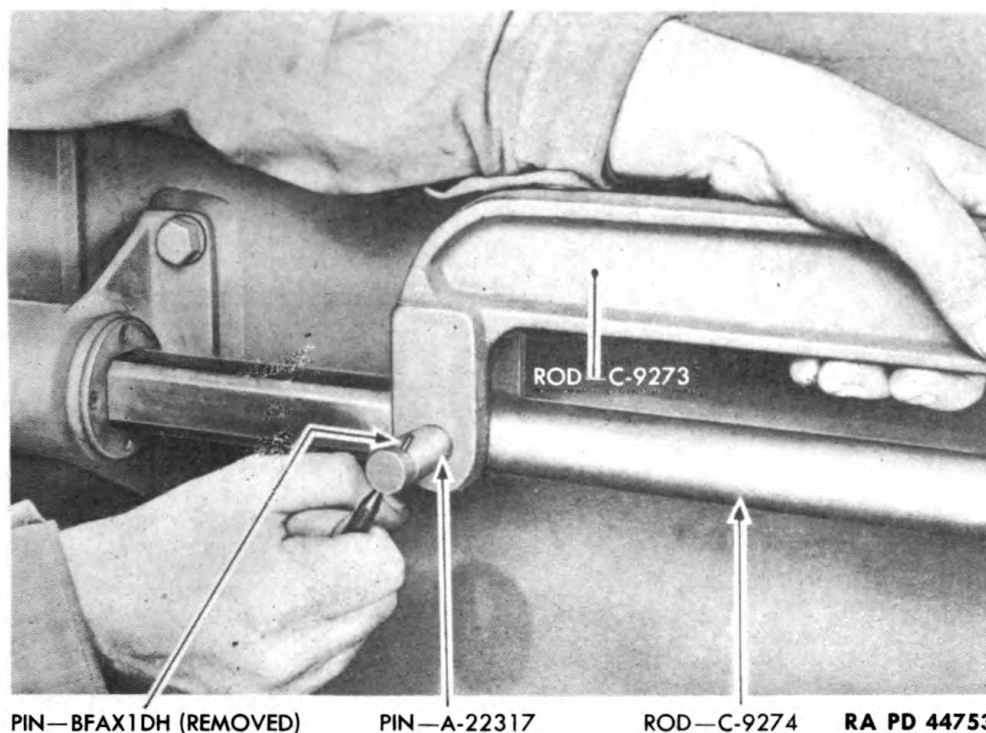


Figure 103—Removing Pin from Variable Recoil Connecting Rod

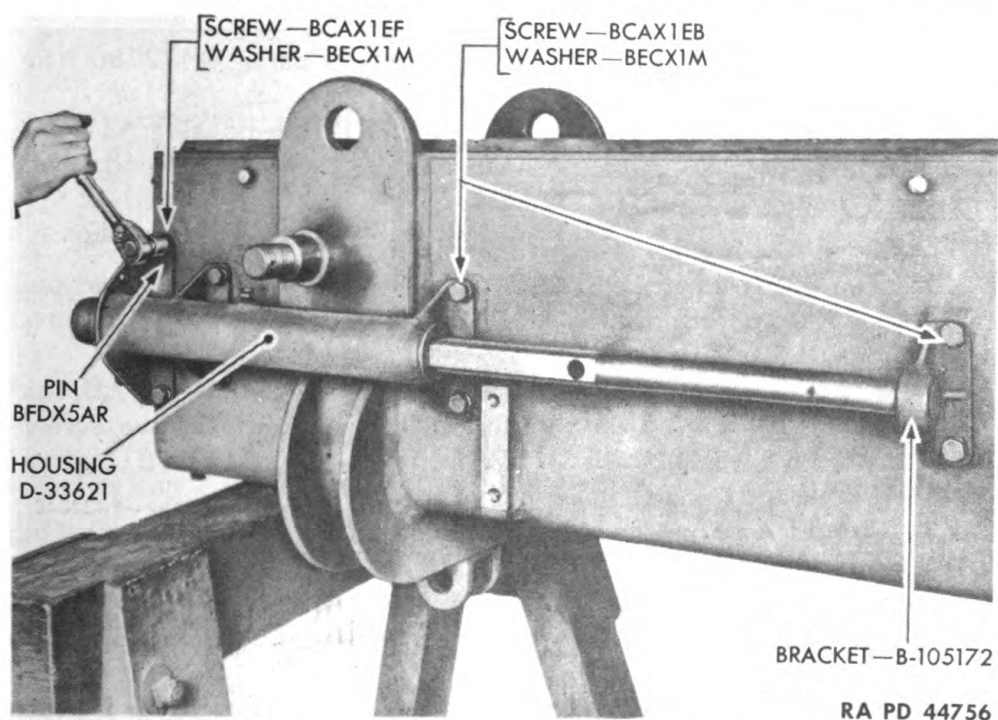


Figure 104—Removing Variable Recoil Cam Housing

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

ROD—D-8897

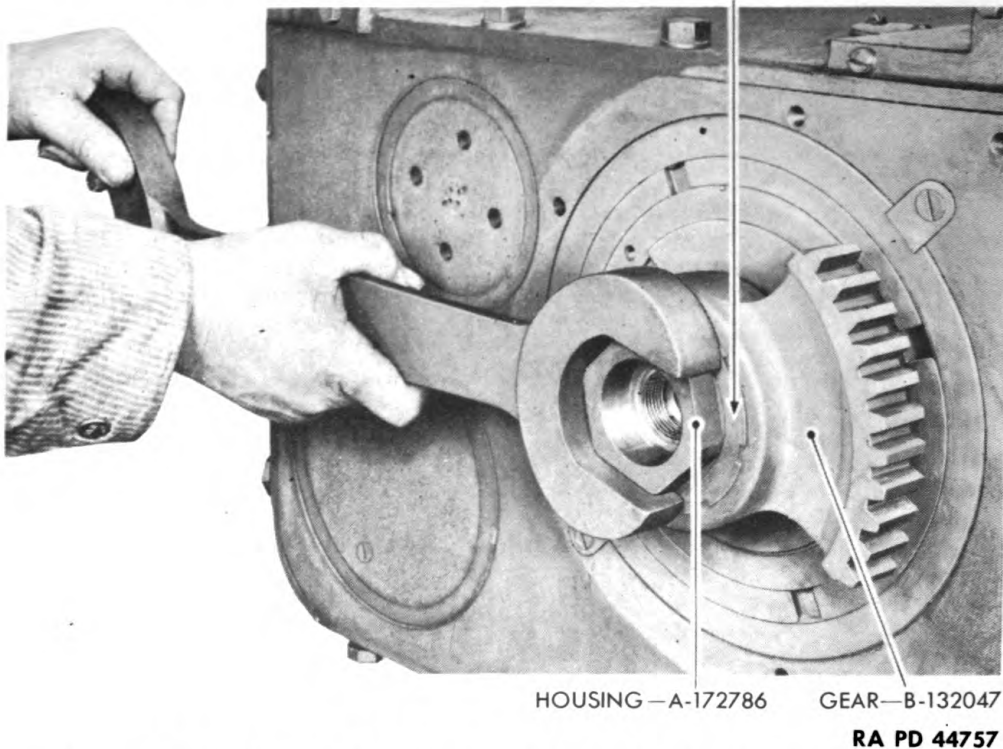


Figure 105—Removing Replenisher Tube Packing Housing

(2) Remove set screw BCTX1AC from housing A172786 (fig. 102).

(3) Unscrew and remove retainer A172789 from housing A172786 (fig. 102). Replenisher tube, retainer, glands, packing, and collar will come away with retainer (fig. 113).

e. Remove Variable Recoil Mechanism.

(1) Remove two cotter pins BFAX1DH from pin A22317 and pull pin A22317 from rods C9273 and C9274. Lift rod C9273 from rod C9274 (fig. 103).

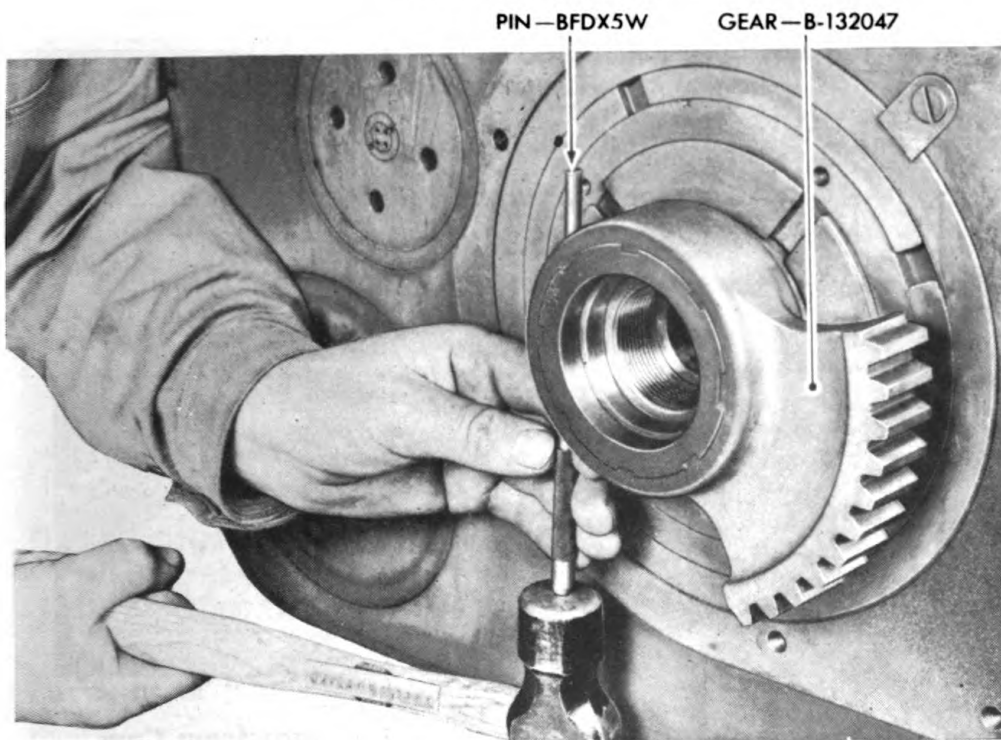
(2) Remove two screws BCAX1EF, four screws BCAX1EB, and six washers BECX1M from housing D33621. Remove two screws BCAX1EB and washers BECX1M from bracket B105172, and remove variable recoil mechanism assembly (fig. 104).

(3) Should it be necessary to remove recoil control rod gear (fig. 105), proceed as follows:

(a) Unscrew housing A172786 from recoil control rod D8897 with bogie trunnion nut and lifting screw shackle pin wrench B105336 (fig. 105).

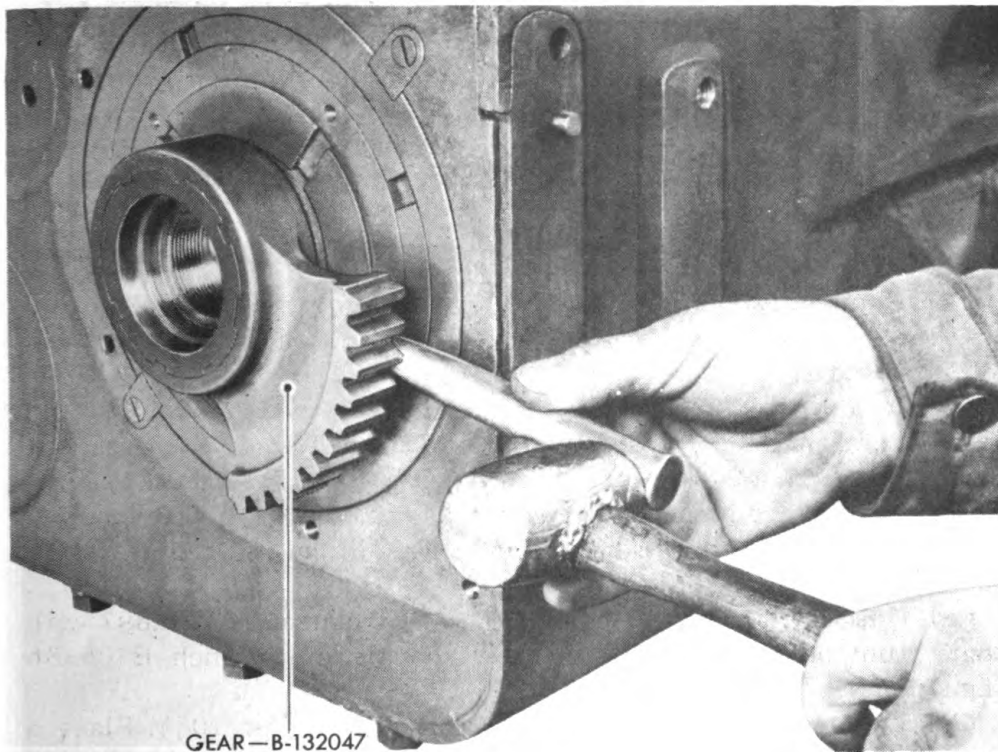
(b) Drive pin BFDX5W from gear B132047 (fig. 106). Place a brass drift between gear and cradle, and tap drift lightly to force gear off recoil control rod (fig. 107).

RECOIL MECHANISM



RA PD 44758

Figure 106—Removing Pin from Recoil Control Rod Gear



RA PD 44759

Figure 107—Removing Recoil Control Rod Gear

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

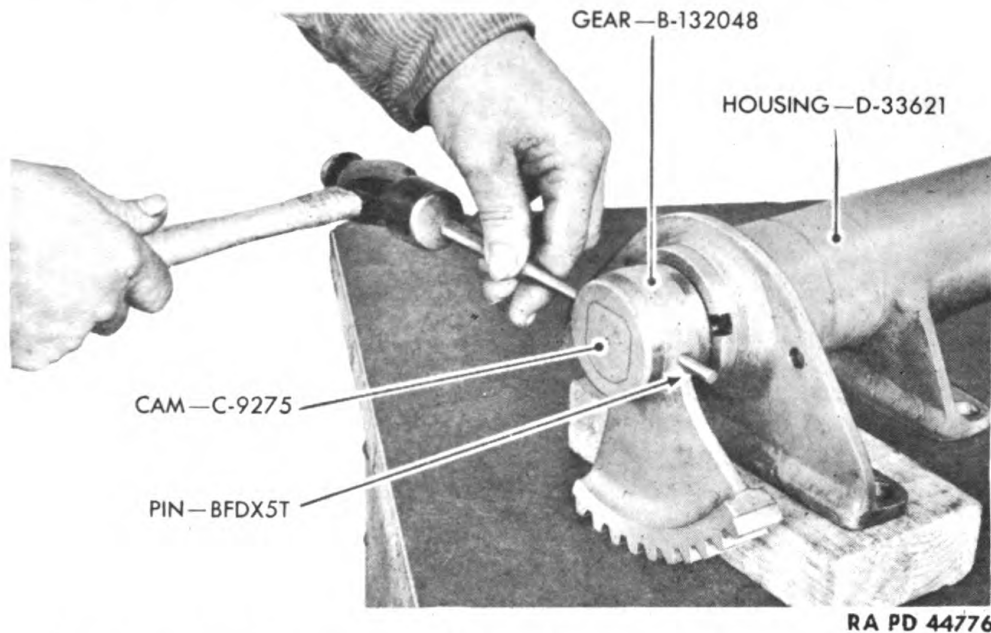


Figure 108—Removing Variable Recoil Cam Gear from Cam

52. DISASSEMBLE VARIABLE RECOIL MECHANISM.

- a. Place the variable recoil mechanism on two wood blocks, 2 x 4 x 6 inches. Drive pin BFDX5T from gear B132048 and cam C9275 (fig. 108). Remove gear.

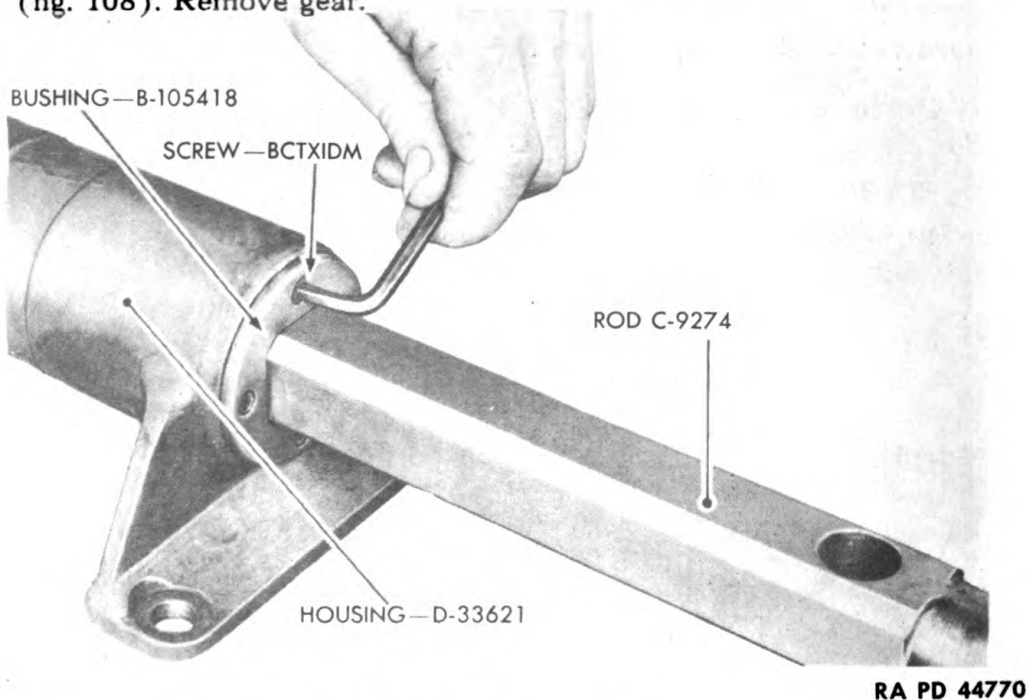
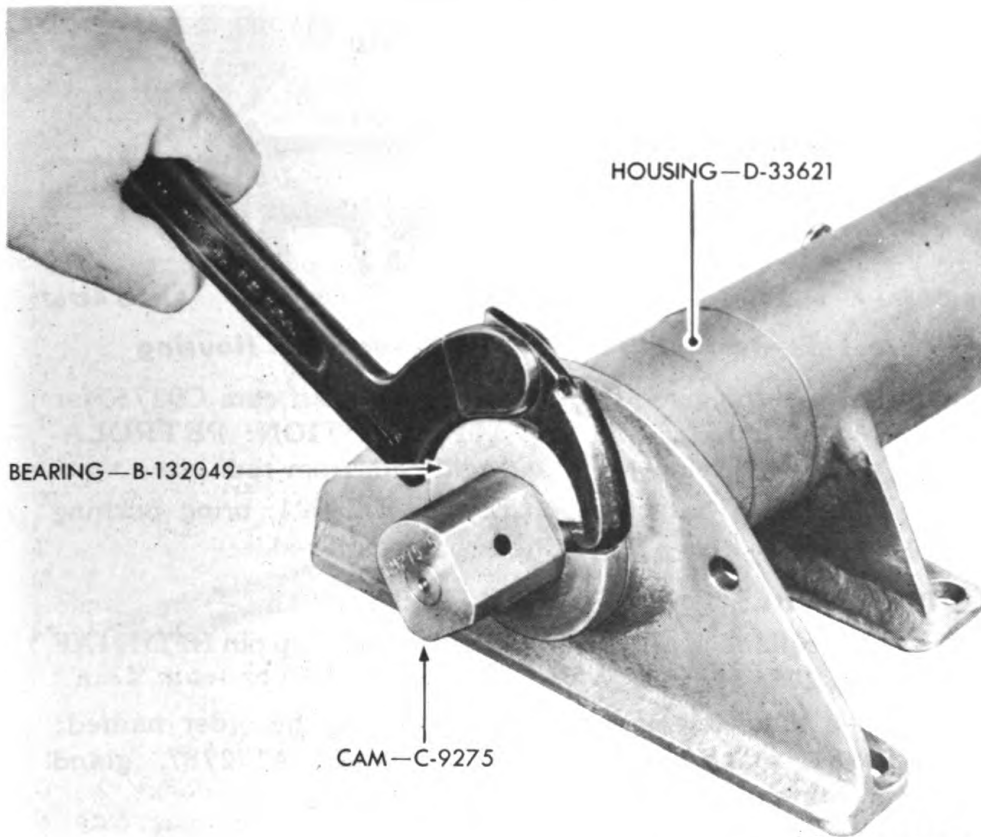


Figure 109—Removing Bushing from Variable Recoil Cam Housing

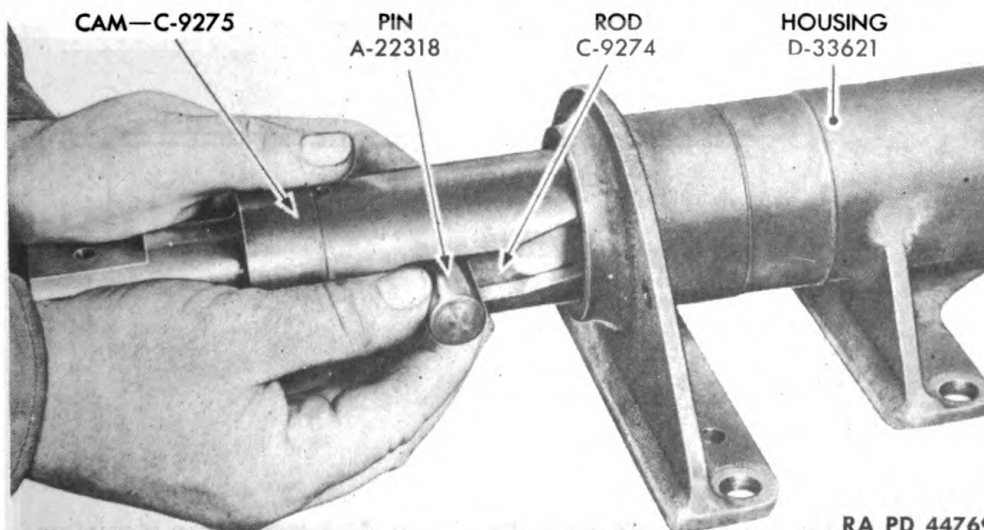
RECOIL MECHANISM



RA PD 44774

Figure 110—Removing Bearing from Variable Recoil Cam Housing

- b. Remove four screws BCTX1DM from bushing B105418 (fig. 109).
- c. Remove bearing B132049 from housing D33621 (fig. 110).



RA PD 44769

Figure 111—Removing Pin from Cam and Rod

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

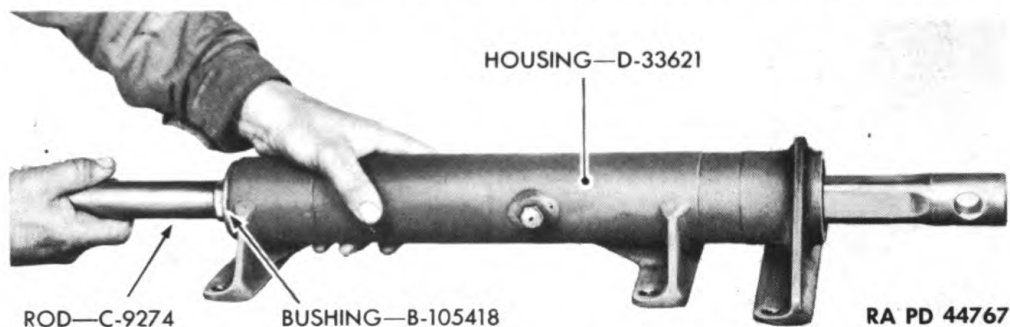


Figure 112—Removing Rod and Bushing from Housing

d. Pull valve turning rod C9274, bringing with it cam C9275, far enough to remove pin A22318 (fig. 111). **CAUTION:** PETROLATUM will spurt out. Remove pin and pull cam from rod.

e. Pull rod C9274 back through housing D33621; bring bushing B105418 with the rod (fig. 112). Slide bushing off rod.

53. DISASSEMBLE REPLENISHER TUBE.

a. Place the collar end of tube on a wood block. Tap pin BFDX1AF from collar A172781 (fig. 113).

b. Slide the following parts from the tube in the order named: collar A172781, gland A172784, two packings A172787, gland A172785, and retainer A172789.

54. DISASSEMBLE REPLENISHER.

a. Screw the short threaded end of the replenisher piston extractor 15-5-379 (fig. 22) fully into rear of piston; then screw extractor washer and nut up tight against replenisher guide B167259 (fig. 114).

b. Remove screw BCTX1BF from guide B167259.

c. Using face spanner wrench BH 49 A and B, unscrew guide B167259 from housing D36831. As guide is unscrewed, it will turn

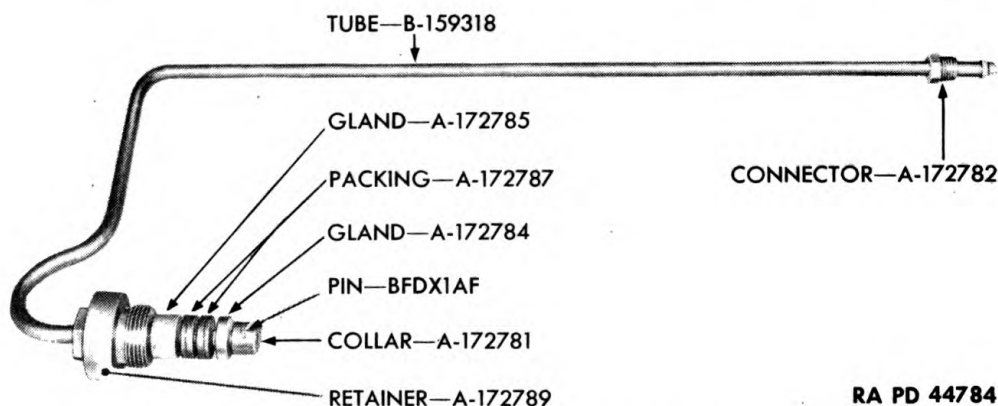


Figure 113—Replenisher Tube Assembly

RECOIL MECHANISM

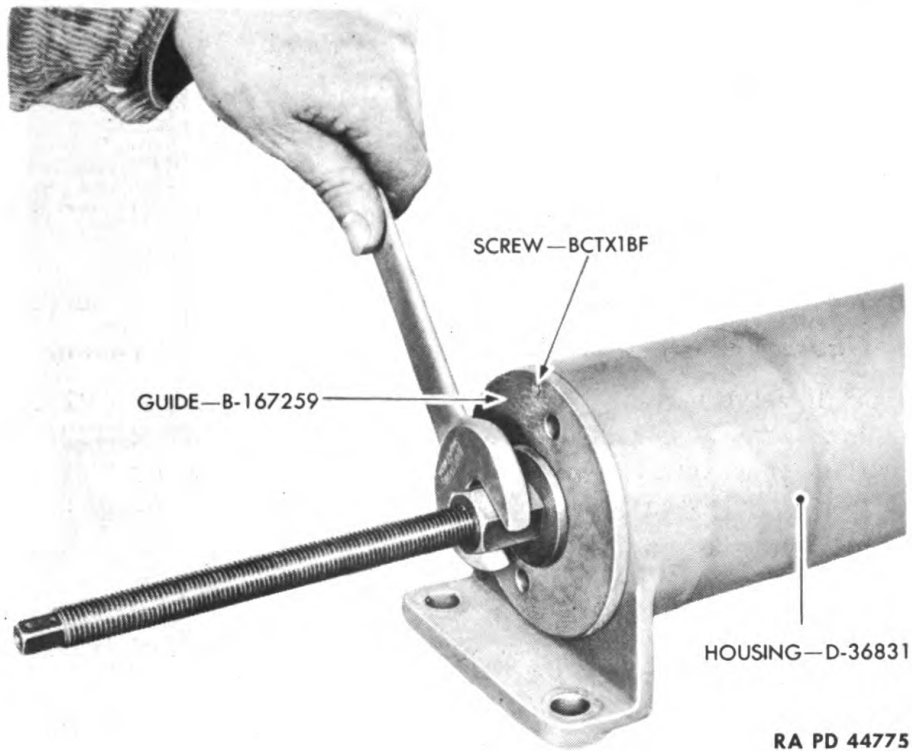


Figure 114—Installing Replenisher Piston Extractor

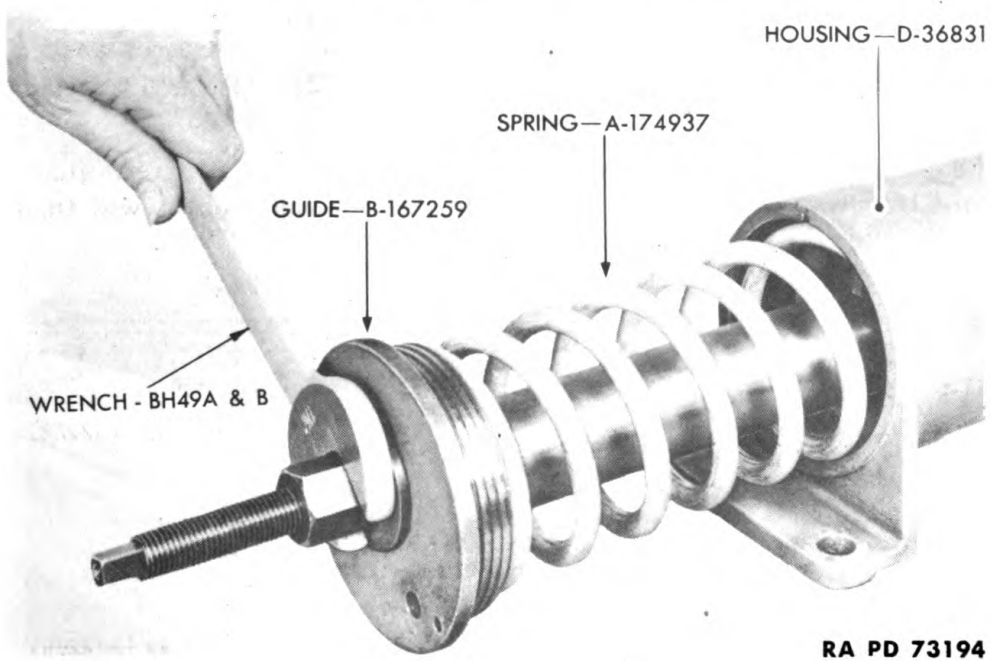


Figure 115—Removing Replenisher Spring

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

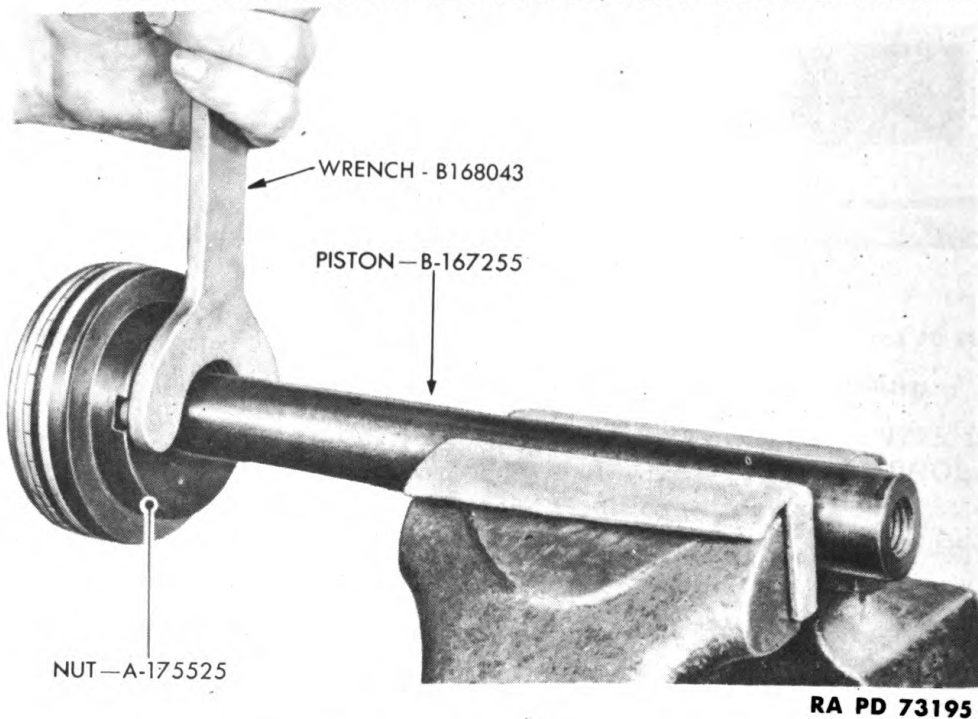


Figure 116—Removing Nut from Replenisher Piston

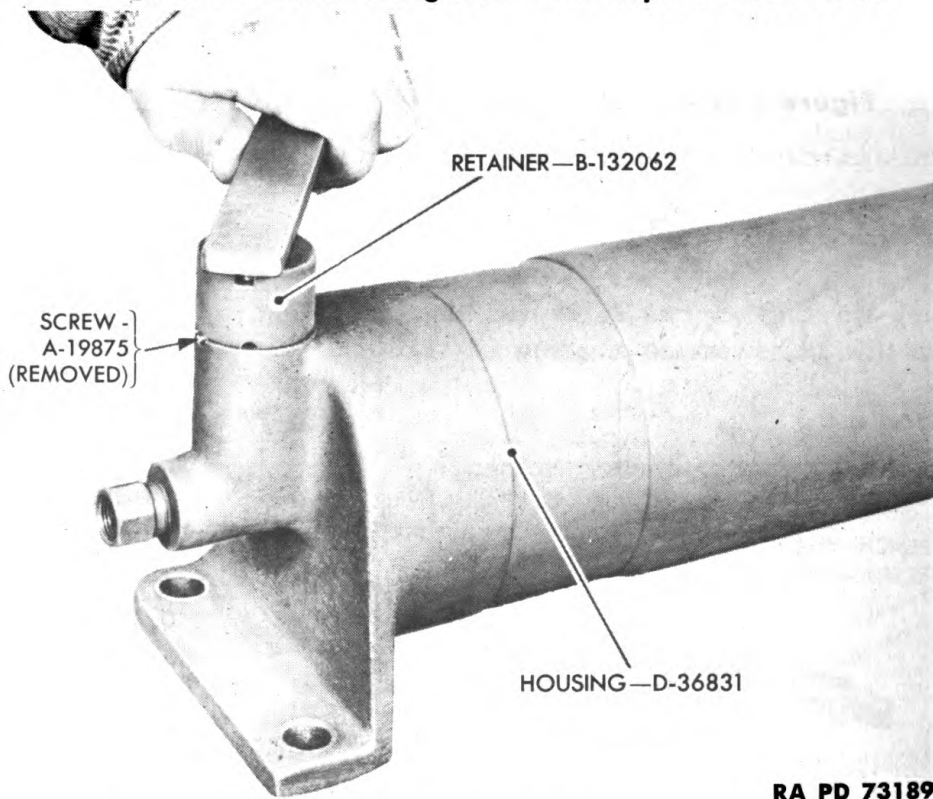
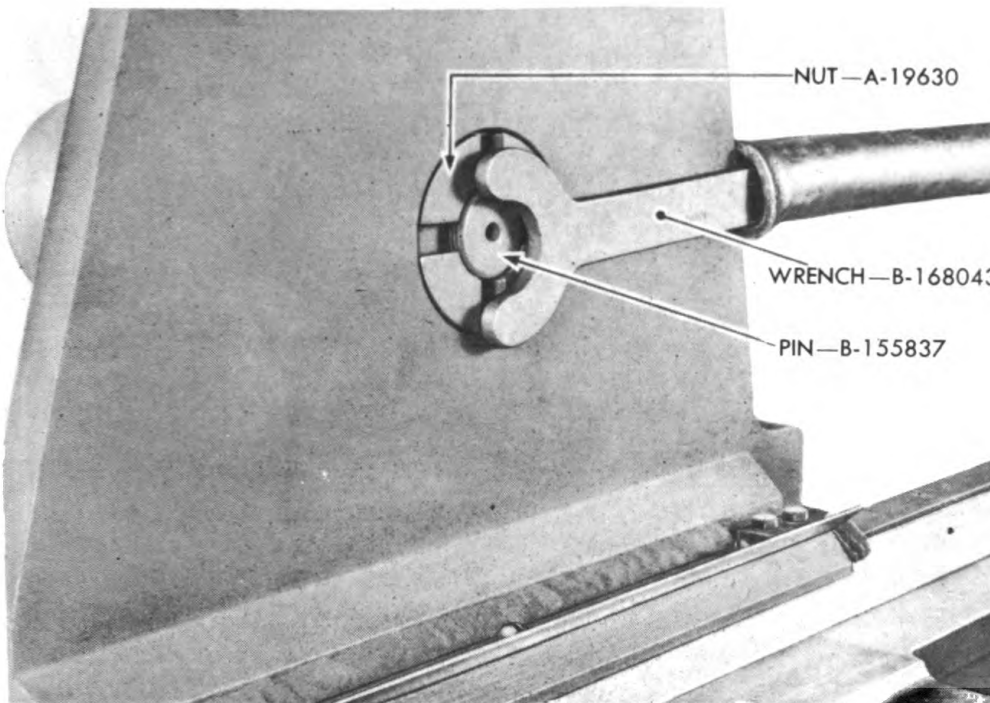


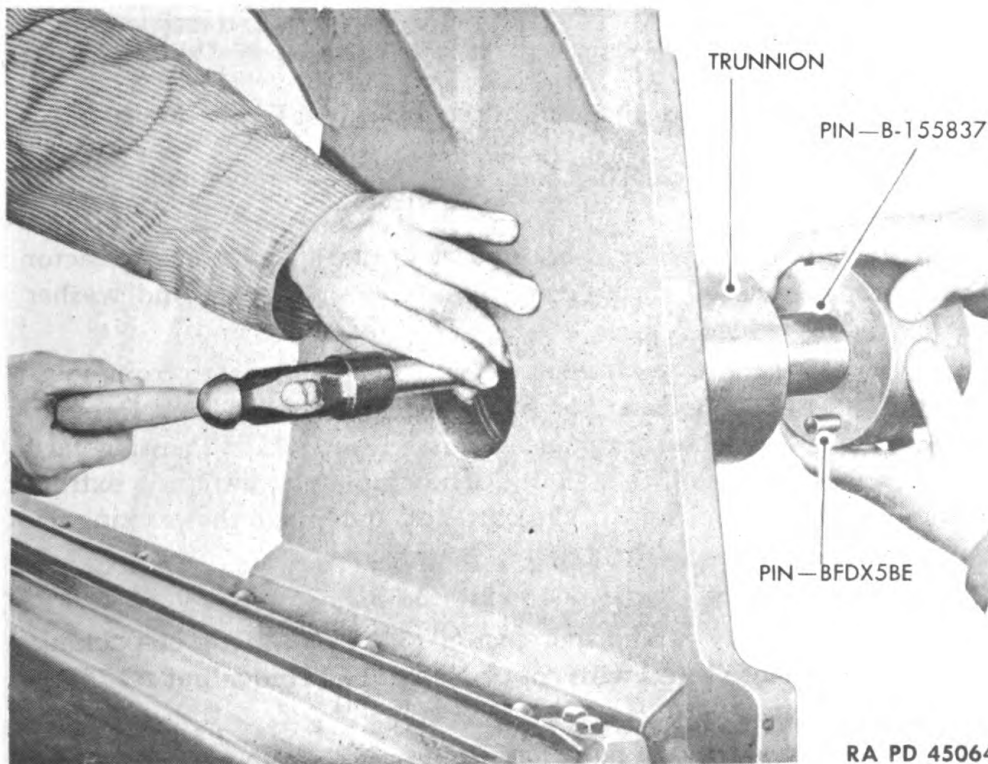
Figure 117—Removing Retainer from Replenisher

RECOIL MECHANISM



RA PD 44747

Figure 118—Removing Cradle Trunnion Pin Nut



RA PD 45064

Figure 119—Removing Cradle Trunnion Pin

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

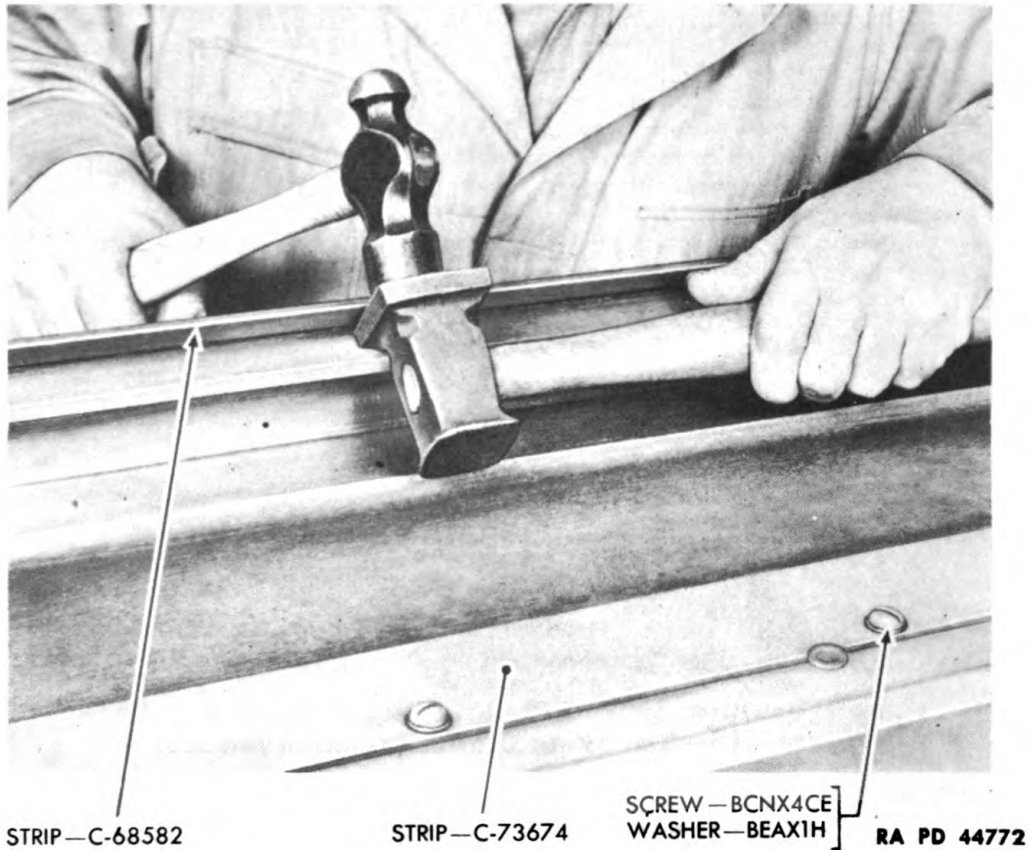


Figure 120—Straightening Cradle Guide Cover Strip

the extractor nut off, releasing compression of the replenisher spring A174937 (fig. 115).

d. After guide is free from housing, continue to unscrew extractor nut to fully release all spring compression. Remove nut and washer from extractor.

e. Partially withdraw extractor, guide, spring, and piston from housing as a unit until replenisher piston nut A175525 is exposed. Remove guide and spring. Loosen replenisher piston nut A175525 using face spanner wrench B168043 (fig. 5). Then completely withdraw extractor and piston from housing. Take care not to damage the packing assembly or silver rings as the piston is withdrawn.

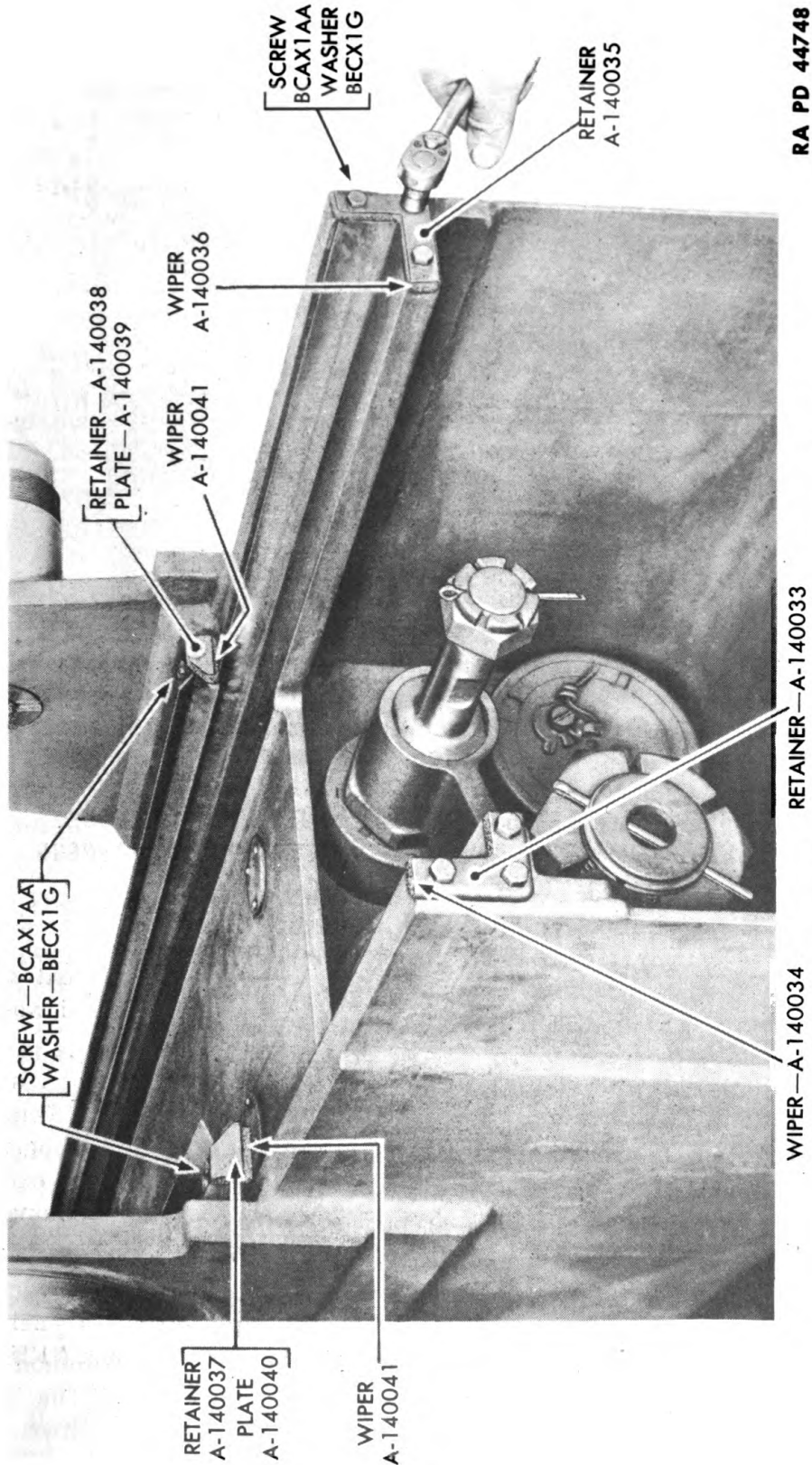
f. Unscrew extractor from piston B167255.

g. To disassemble replenisher piston for replacement of packing, place piston in a vise fitted with copper jaws and remove nut A175525 (fig. 116).

NOTE: Always use new packing.

h. The following will come away from the piston in the order

RECOIL MECHANISM



RA PD 44748

Figure 121—Removing Gun Rail Lower Rear Wiper

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

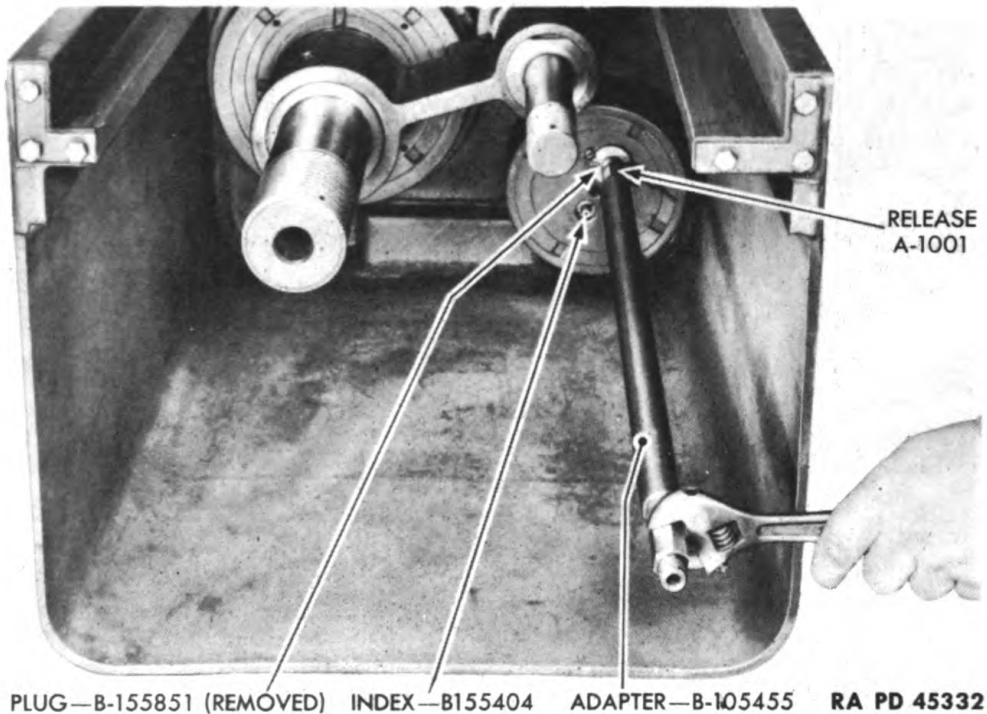


Figure 122—Installing Oil Release and Adapter in Recuperator Cylinder Rear Head

named after nut A175525 is removed: spring B155627, gland A175527, ring B170758, packing A175831, filler A158878, ring B170758, and ring B170760 (fig. 141).

i. Disassemble Replenisher Filling and Drain Valve.

- (1) Remove screw A19875 from retainer B132062 (fig. 117).
- (2) Using improvised spanner wrench, remove retainer B132062 from housing D36831 (fig. 117).
- (3) Remove gasket A166277, valve A166282, and spring A167163 from replenisher housing (fig. 140).

55. MAINTENANCE AND REPAIR OF CRADLE.

a. General.

- (1) Clean all parts thoroughly with SOLVENT, dry-cleaning.
- (2) Replace all worn or damaged parts.

b. Replace Worn or Damaged Cradle Trunnion Pin (figs. 95, 118, and 119).

- (1) Unscrew and remove nut A19630 from cradle trunnion pin, left, B155837 or right, B132036, whichever is to be replaced (fig. 118).
- (2) Drive cradle trunnion pin out of trunnion with a brass drift and hammer (fig. 119).

RECOIL MECHANISM

(3) Coat mating surfaces of new cradle trunnion pin, small dowel pin BFDX5BE, and trunnion with COMPOUND, rust-preventive, light.

(4) Line up small dowel pin with hole in trunnion and drive new cradle trunnion pin into position in trunnion with a small wood block and hammer.

(5) Screw cradle trunnion pin nut A19630 in place and tighten. Stake nut to pin.

(6) Clean the exposed surface of cradle trunnion pin with SOLVENT, dry-cleaning.

c. Repair Burred Cradle Trunnion or Trunnion Pin.

(1) Remove the score or bur with a smooth file. Remove just enough metal to eliminate score or bur.

(2) Clean thoroughly with SOLVENT, dry-cleaning.

d. Repair Bent Cradle Guide Cover Strip.

(1) If not too badly bent, straighten the deformed cradle guide cover strip without removing it from cradle (fig. 120).

(2) If badly bent, remove strip by removing screws BCNX4CE and washers BEAX1H, and install a new strip.

e. Repair Bruised or Scored Cradle Guide.

(1) Remove the score, bruise, or bur with a flat scraper. Remove just enough metal to smooth the surface of guide.

(2) Polish with CLOTH, crocus, and clean entire guide with SOLVENT, dry-cleaning.

f. Replace Worn Gun Rail Wiper (figs. 95, 94, and 121).

(1) To replace gun rail lower rear wiper A140036 or A140034, remove screws BCAX1AA and washers BECX1G (fig. 121). Remove retainer A140035 or A140033. Replace worn wiper with a new one. Assemble retainer to cradle.

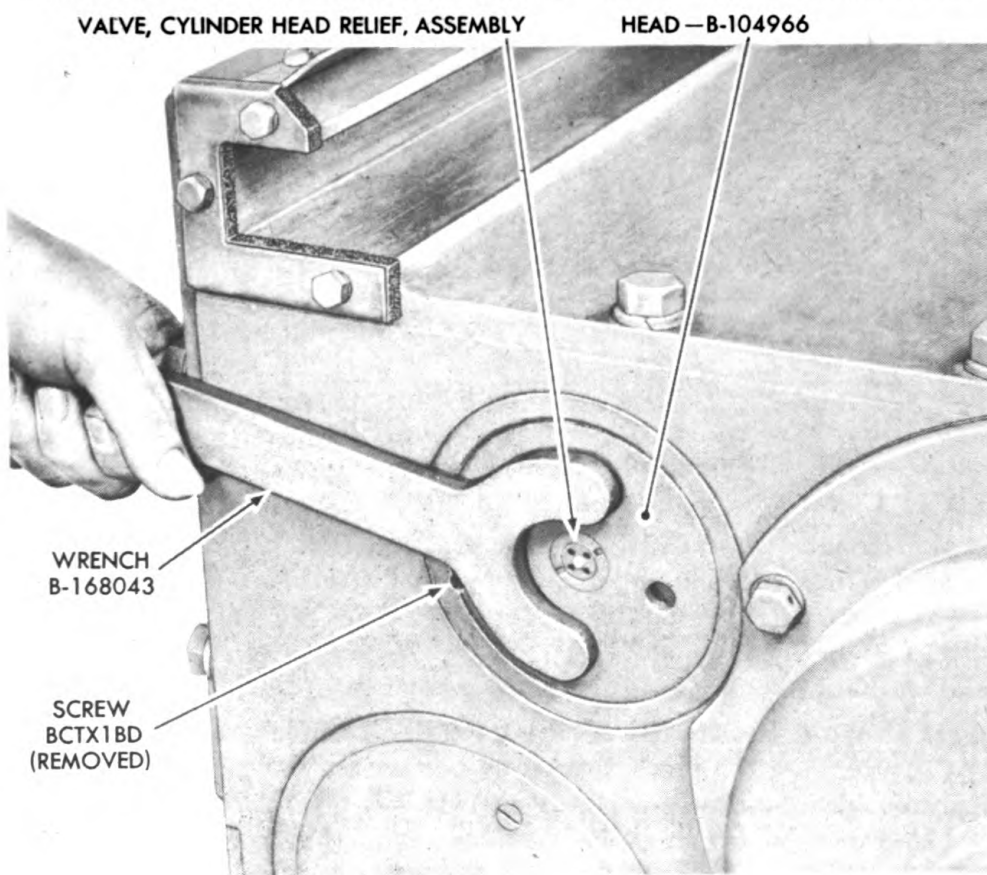
(2) To replace gun rail upper rear wiper A140041, remove screws BCAX1AA and washers BECX1G. Remove retainer A140037 and plate A140040 or retainer A140038 and plate A140039 (fig. 95). Replace worn wiper with a new one. Assemble plate and retainer to cradle.

(3) To replace gun rail front wiper A139936 or A140051, remove screws BCAX1AA and washers BECX1G (fig. 94). Remove screw BCFX2DH and washer BECX1G from retainer A140032. Remove retainer A139935 or A140032. Replace worn wiper with new one. Assemble retainer to cradle.

56. MAINTENANCE AND REPAIR OF RECOIL MECHANISM.

a. Replace Damaged or Worn Recoil and Counterrecoil Piston Rod Yoke.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 45323

Figure 123—Removing Counterrecoil Cylinder Head

(1) Remove filling and drain plug B155851 from recuperator cylinder rear head (fig. 122). Screw oil release A1001 in adapter B105455; then screw oil release and adapter into filling and drain plug opening. Turn adapter and oil release to drain off the reserve oil into a suitable container. When oil index B155404 stops moving inward, reserve oil is drained off.

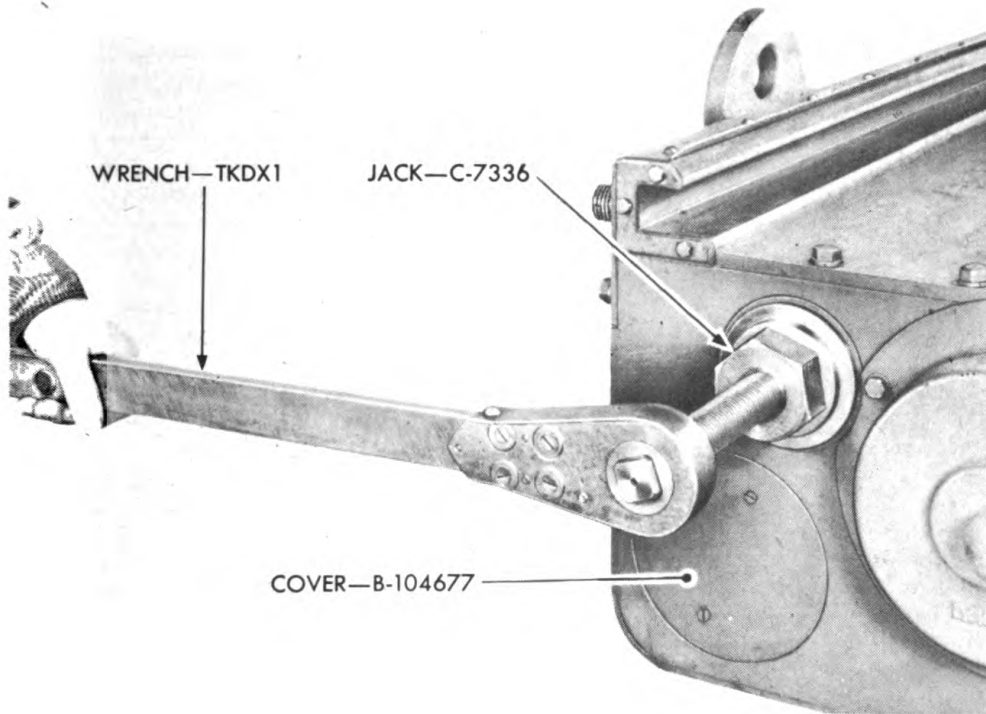
(2) Remove screw BCTX1BD, and unscrew counterrecoil cylinder (front) head B104966 with face spanner wrench B168043 (fig. 123).

(3) Screw counterrecoil piston screw jack C7336 into counterrecoil cylinder front head opening. Using large ratchet wrench TKDX1, force the counterrecoil and recoil piston rods out of battery about an inch or two (figs. 124 and 125).

(4) Permit oil to drain from system into a 5-gallon container until it ceases to flow. Remove adapter and oil release from filling and drain plug opening in recuperator cylinder rear head.

(5) Remove screw BCKX2CD and pin A135607 from yoke C9874 and end D28130. Turn screw jack and force counterrecoil piston rod out several inches farther. Yoke C9874 will be carried back with

RECOIL MECHANISM



RA PD 45324

Figure 124—Jacking Counterrecoil Piston Rod

counterrecoil piston rod far enough to permit removal of end C9873. The recoil piston rod will not come back with counterrecoil rod after yoke has been disconnected from end D28130. Remove screw BCTX1BL and unscrew nut A167445 from end C9873 (fig. 125).

(6) Slide nut and yoke toward recuperator cylinder rear head far enough to expose pin A19461 which secures end C9873 to counterrecoil piston rod. Tap pin A19461 out and unscrew end C9873. Slide yoke C9874 and nut A167445 from piston rod (fig. 126).

(7) Coat, with a film of grease, the threads of yoke nut A167445, the recoil and counterrecoil piston rods where they project from the cylinders, the mating surfaces of recoil and counterrecoil rod ends, and the new yoke. Slide the yoke nut A167445 on the counterrecoil piston rod. Follow with the new recoil and counterrecoil piston rod yoke. **NOTE:** The stop lug on the yoke must be toward the cylinder heads (fig. 126).

(8) Coat counterrecoil rod and end threads with COMPOUND, rust-preventive, light. Screw counterrecoil rod end in place on counterrecoil rod. Line up hole in rod end and rod. Tap the straight pin into place (fig. 126).

(9) Slide the recoil and counterrecoil piston rod yoke forward into place on the counterrecoil piston rod end. Tighten piston rod end yoke nut. Secure nut with safety set screw (fig. 125).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

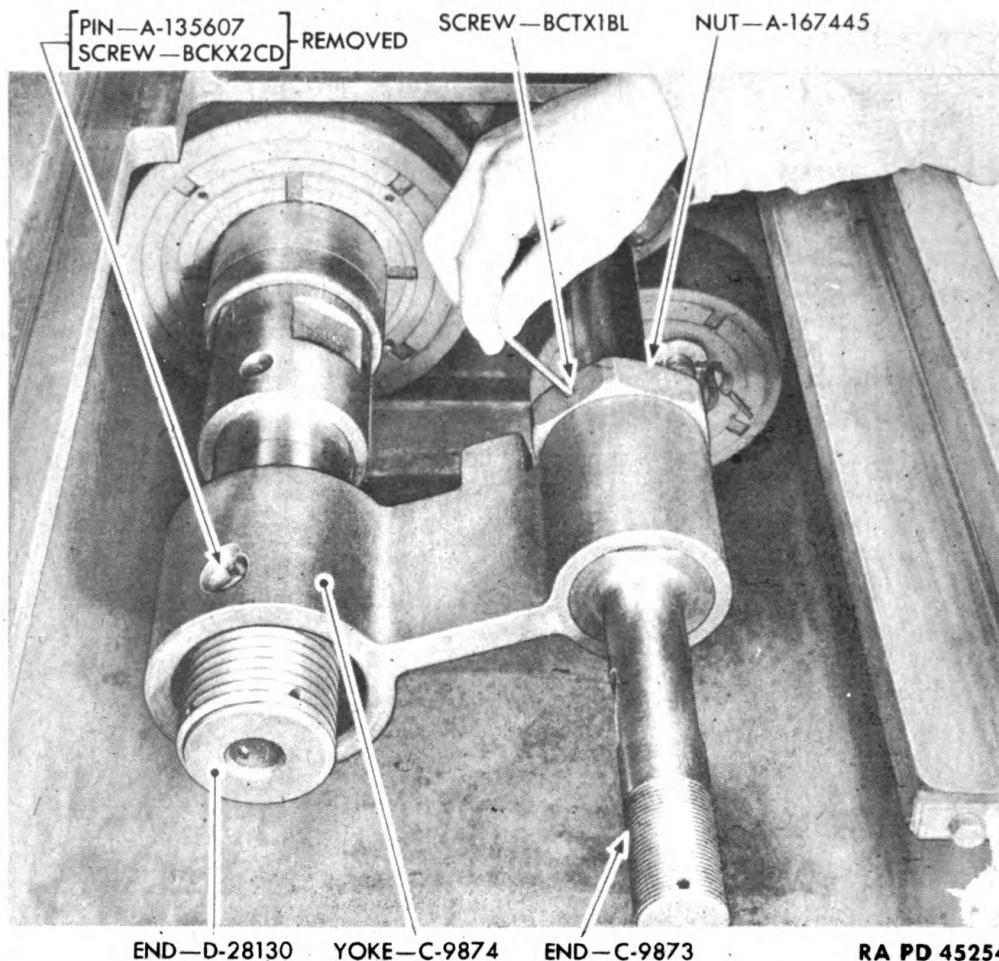


Figure 125—Removing Screw from Nut on Counterrecoil Piston Rod End

(10) Remove screws BCNX2AE and washers BEAX1F from the two purge plug handhole covers A142019 over the recoil cylinder. Remove two covers and gaskets; then remove the two purge plugs A19804 from recoil cylinder. **NOTE:** There are three purge plug handhole covers; two over the recoil cylinder (front and rear), and one over counterrecoil cylinder near the rear end of the cradle (figs. 94 and 95).

(11) Screw vent pipe (short, improvised tool, fig. 23) into recoil cylinder rear purge plug hole. Then screw the filling pipe (long, improvised tool, fig. 23) into recoil cylinder front purge plug hole.

(12) Remove screw jack C7336 from counterrecoil cylinder front head opening (fig. 124). Screw counterrecoil cylinder front head in place with face spanner wrench B168043, and secure with safety set screw (fig. 123).

(13) Raise rear end of recoil mechanism and place a wood block between cradle and wooden horse so that cradle is at an angle of at least 5 degrees.

RECOIL MECHANISM

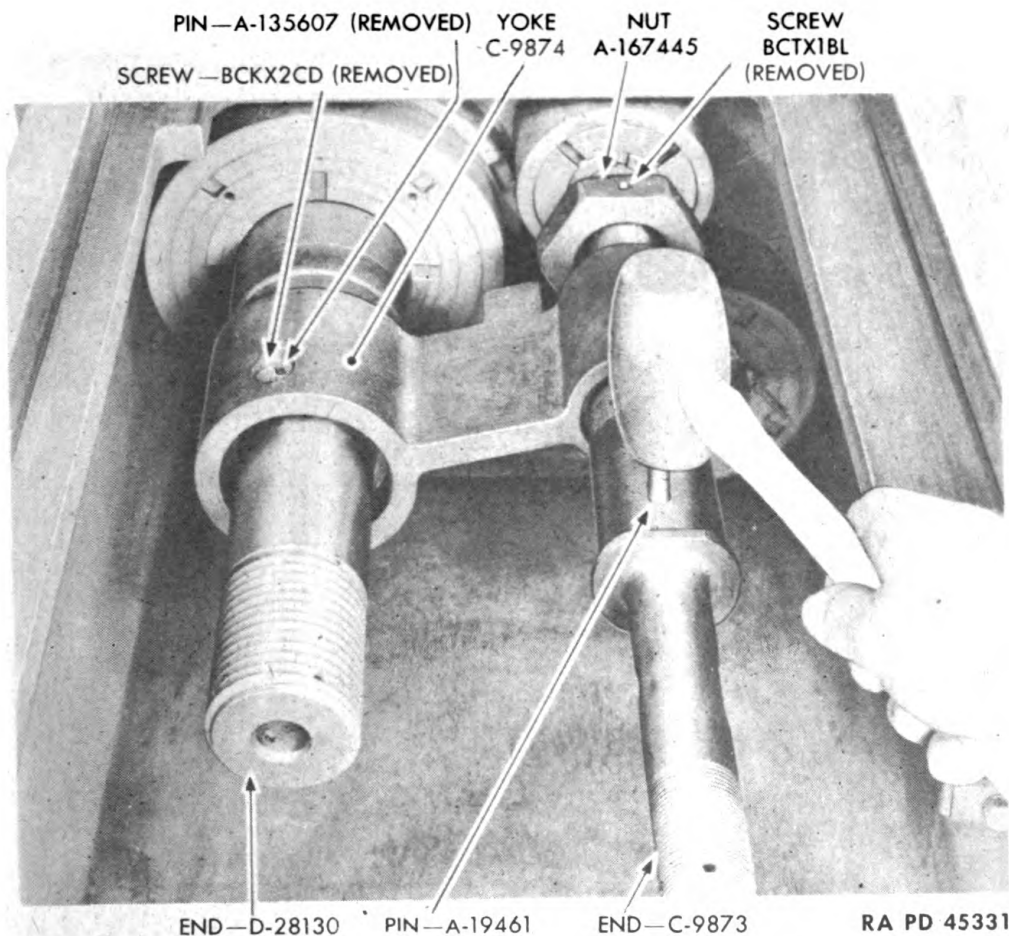
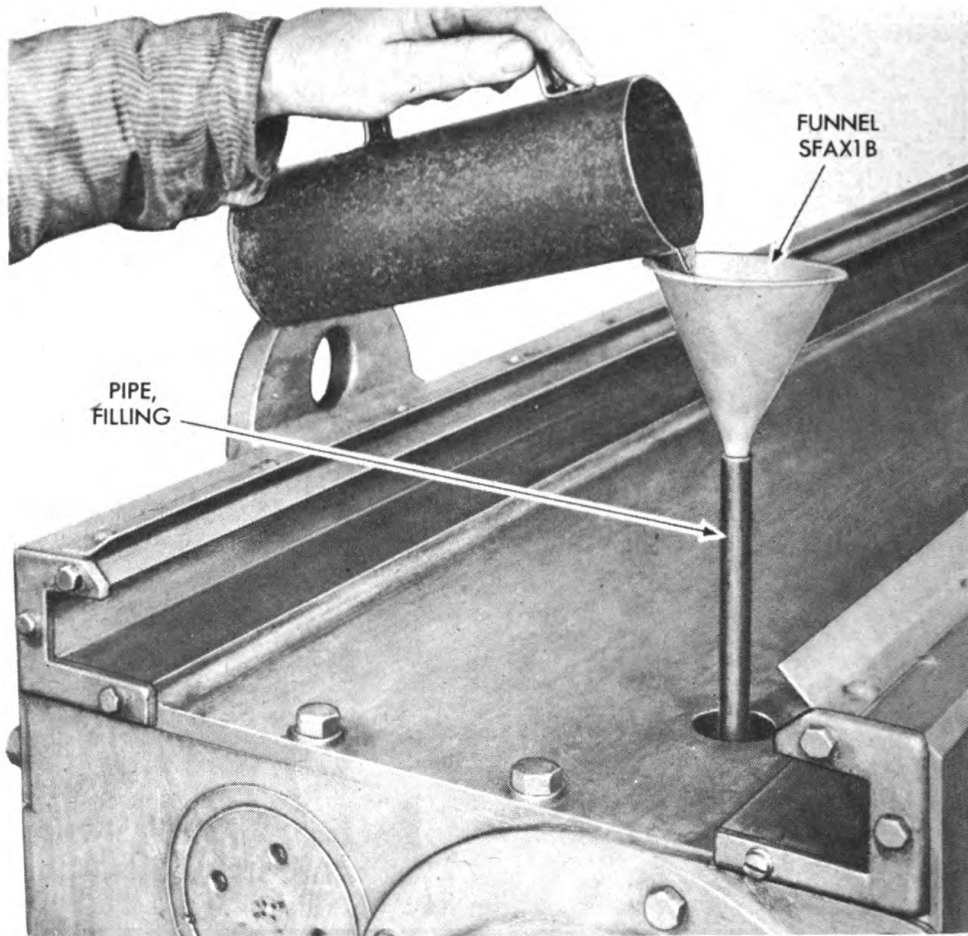


Figure 126—Removing Pin from Counterrecoil Piston Rod End and Rod

(14) Pour OIL, recoil, heavy, through funnel inserted in front purge plug hole (fig. 127). The oil will run in slowly as it must run up hill and force air out of the recoil cylinder. This is the purpose of raising the rear end of cradle. When oil seems to stop running in, remove funnel from filling pipe and blow through pipe to force air from recoil cylinder. The air will escape through the small vent pipe screwed into the rear purge plug opening. Continue pouring OIL, recoil, heavy, into the cylinder until it flows out the top of the small vent pipe in the rear purge plug opening. When the oil overflows and is free from bubbles, the recoil cylinder is filled and free of air.

(15) Hold filling pipe (front one) closed at top with one finger, and at the same time unscrew and remove the filling pipe from recoil cylinder front plug opening. (Holding the finger tightly over end of pipe prevents oil from running out of pipe while it is being removed.) Screw purge plug into recoil cylinder; put purge plug handhole cover gasket and cover back in place and secure with screws and washers.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 45255

Figure 127—Filling Recoil Cylinder

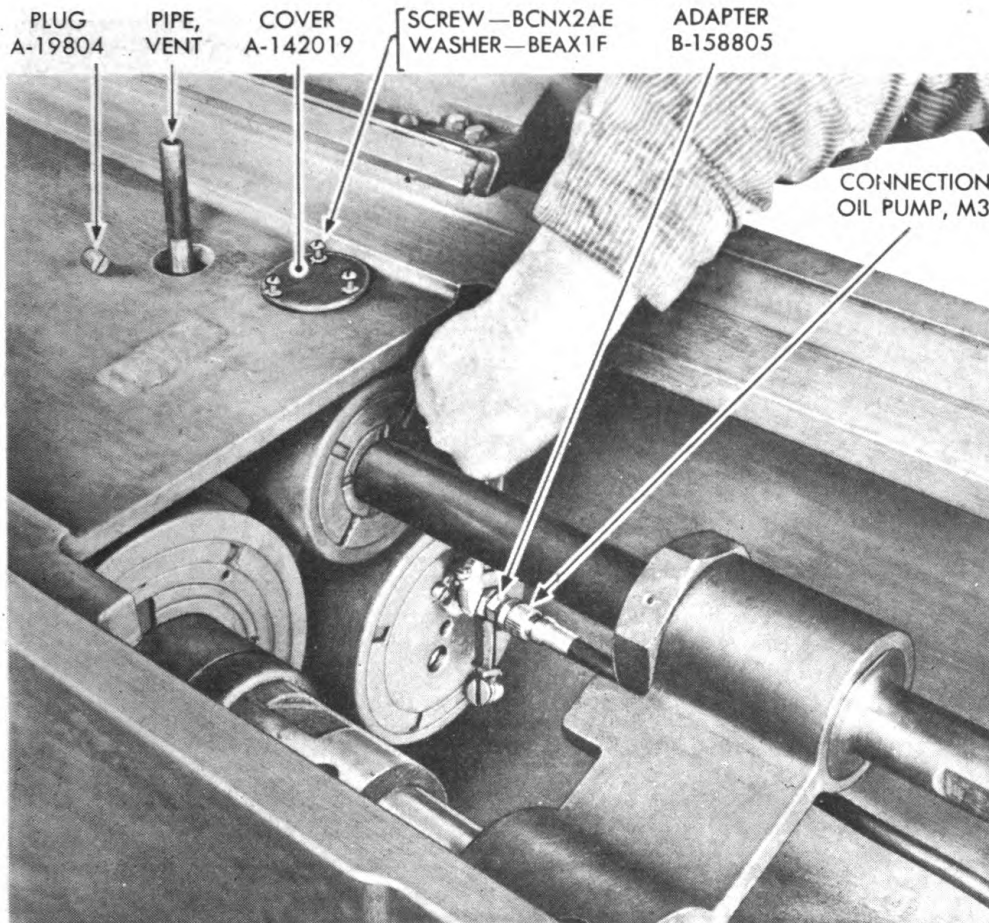
While holding finger over vent pipe, remove pipe. Screw rear purge plug into recoil cylinder, put purge plug handhole cover gasket and cover back in place and secure with screws and washers.

(16) Remove purge plug handhole cover A142019 and gasket A142020 from top of *counterrecoil cylinder* by removing screws BCNX2AE and washers BEAX1F (fig. 95). Remove purge plug A19804 and screw vent pipe (short one) into purge plug opening in counterrecoil cylinder.

(17) Screw adapter B158805 into filling and drain plug hole in recuperator cylinder (fig. 128). Attach oil pump connection to adapter after "purging" oil pump line of air. Pump OIL, recoil, heavy, into recuperator cylinder until oil flows out top of vent pipe just inserted in counterrecoil cylinder. While pumping, count the number of strokes.

(18) When a steady stream of oil, free from bubbles, starts overflowing the vent pipe, place one finger tightly over end of vent pipe. While holding pipe closed, unscrew, and remove it from counterrecoil

RECOIL MECHANISM



RA PD 44836

Figure 128—Refilling Recuperator Cylinder

cylinder. Screw the purge plug in place, put gasket and cover in place, and secure cover with screws and washers.

(19) Resume pumping oil into the recuperator cylinder until the number of strokes required to pump 1 quart of oil has been made. **NOTE:** While oil is being pumped into the recuperator cylinder, the stop lug on yoke C9874 will move up against the recoil and counter-recoil cylinders. Also, the oil index will move outwardly for the first 60 to 70 strokes; thereafter the oil index will remain stationary.

(20) Install recoil piston rod end pin A135607 in place in yoke and end; then secure with machine screw (fig. 129). Disconnect oil pump and remove adapter B158805 from recuperator head. Screw filling and drain plug into place.

b. Repair Filling and Drain Valve (Recuperator Head).

(1) Filling and drain valve failure is indicated by unusual oil leakage into the filling and drain plug recess. Correct as follows:

(a) Drain off the oil reserve as described in subparagraph a (1) above.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

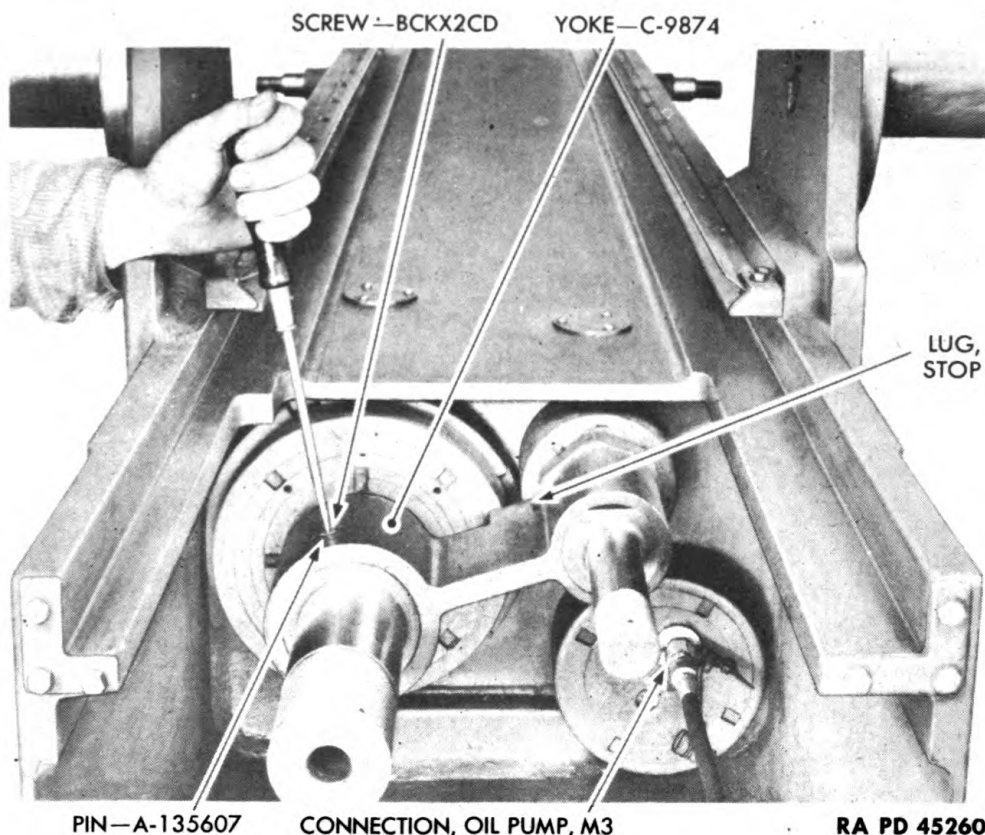


Figure 129—Installing Piston Rod Yoke Screw

(b) Remove screw A167131 from retainer B155401 and housing C67552.

(c) Using improvised wrench (A, fig. 25), unscrew and remove retainer B155401 from housing C67552 (figs. 130 and 131). Leather gasket A166277, and gasket A166281 will come off on the end and from inside the retainer.

(d) Using improvised wrench (B, fig. 25), unscrew and remove housing B155400 from housing C67552. Valve A166282 and spring A167163 are free to be removed (figs. 130 and 132).

(e) Clean all parts thoroughly in SOLVENT, dry-cleaning.

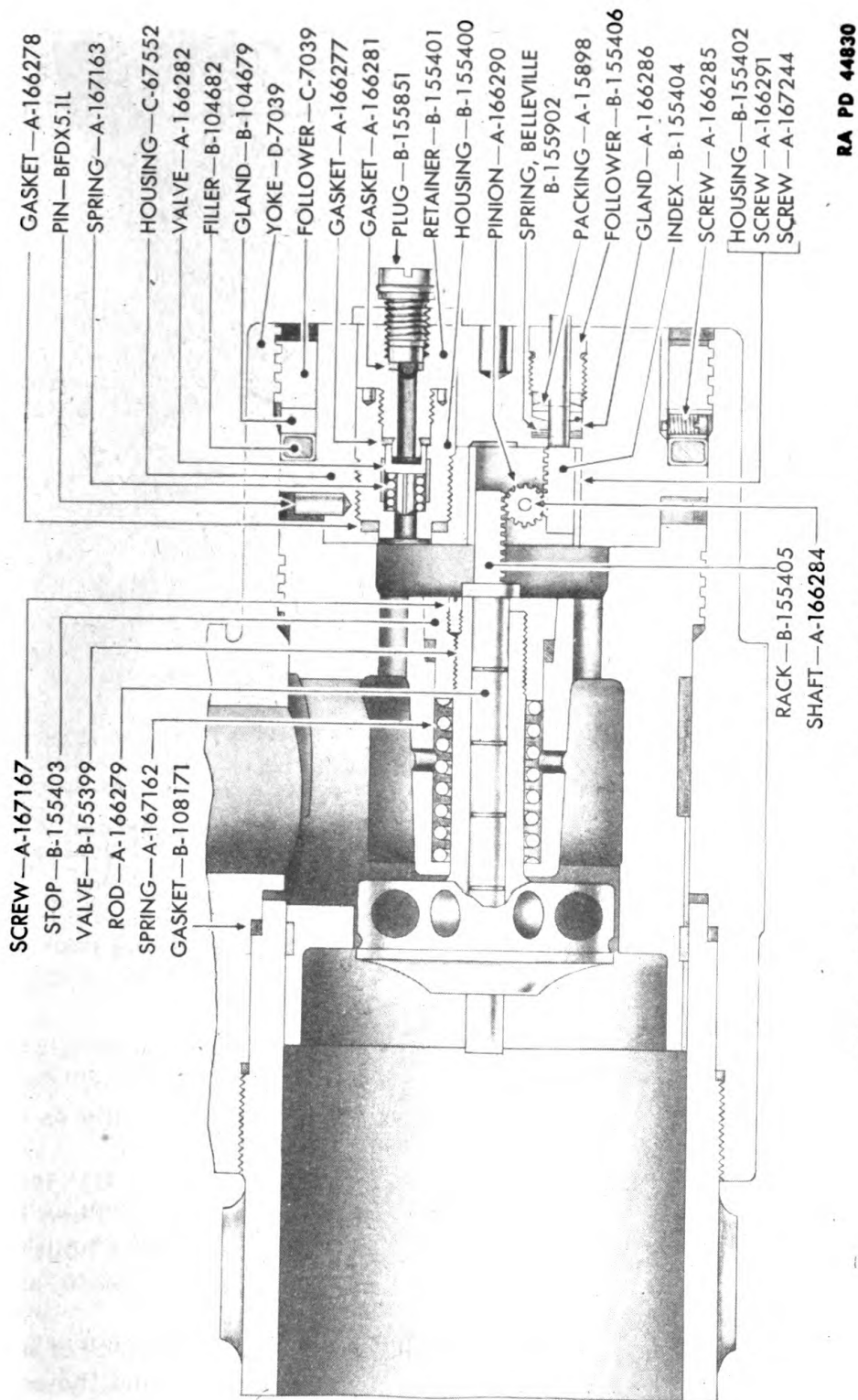
(f) Replace damaged or worn parts.

(g) Valve leakage is usually caused by an unserviceable filling and drain valve leather gasket A166277 or valve A166282. Replace with new gasket, and valve, if required.

(h) Install filling and drain valve spring, valve, and gasket in the valve housing B155400. Screw valve housing into oil index housing C67552 (fig. 130).

(i) Install filling and drain valve retainer in valve housing. Make sure gasket A166281 is in place in the retainer.

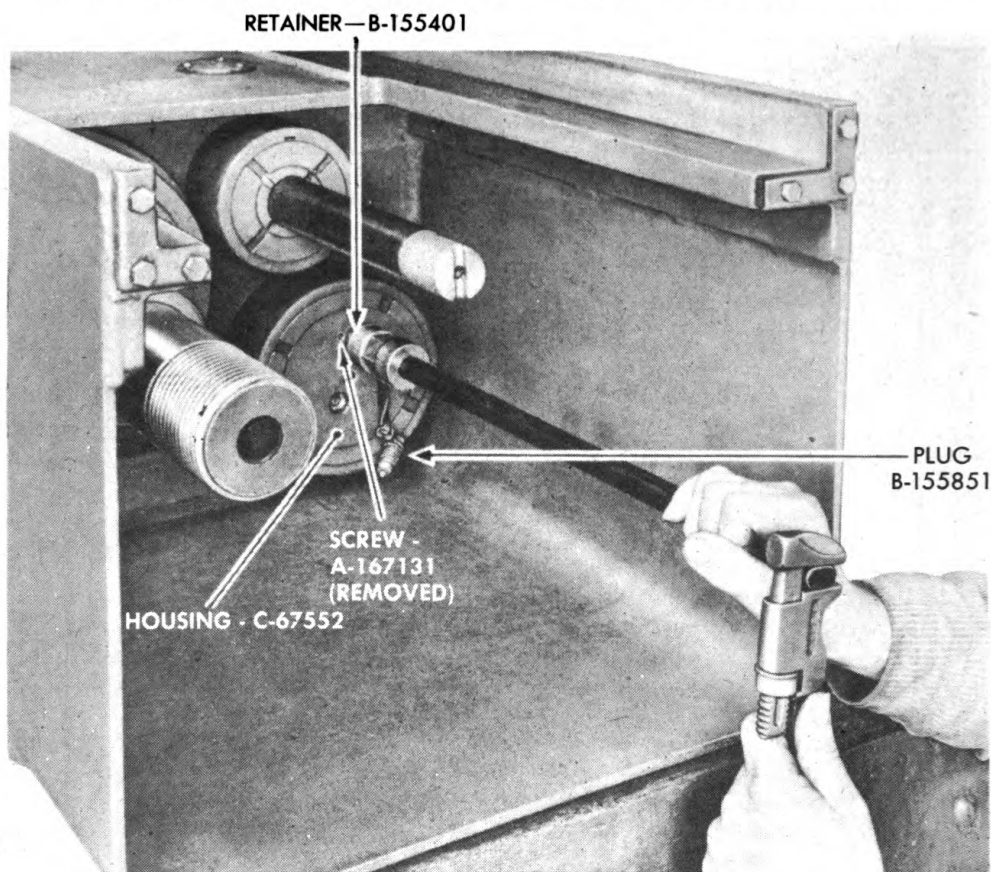
RECOIL MECHANISM



RA PD 44830

Figure 130 — Recuperator Cylinder Rear Head

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 73196

Figure 131—Removing Filling and Drain Valve Retainer

(j) Secure retainer in oil index housing with screw A167131 (fig. 131).

(k) Establish oil reserve and screw filling and drain plug back in place.

c. Oil Index Sticking.

(1) Drain off the oil reserve as explained in subparagraph a (1) above.

(2) Insert 5 fills of the oil screw filler. Tap oil index lightly as oil is inserted.

(3) If oil index still fails to function, remove follower B155406 with wrench A7488 and handle A6788 (figs. 130 and 133). Then insert oil screw filler and force the following parts from oil index housing C67552: gland A166286, two packings A15898, gland A166286, and three Belleville springs B155902.

(4) Install new packing and reassemble. The convex surface of last spring removed (first to be replaced) must face outward; and the convex surface of the middle spring must be toward the convex surface of the spring just inserted. Also, the convex surface of the third spring

RA PD 44799

RECOIL MECHANISM

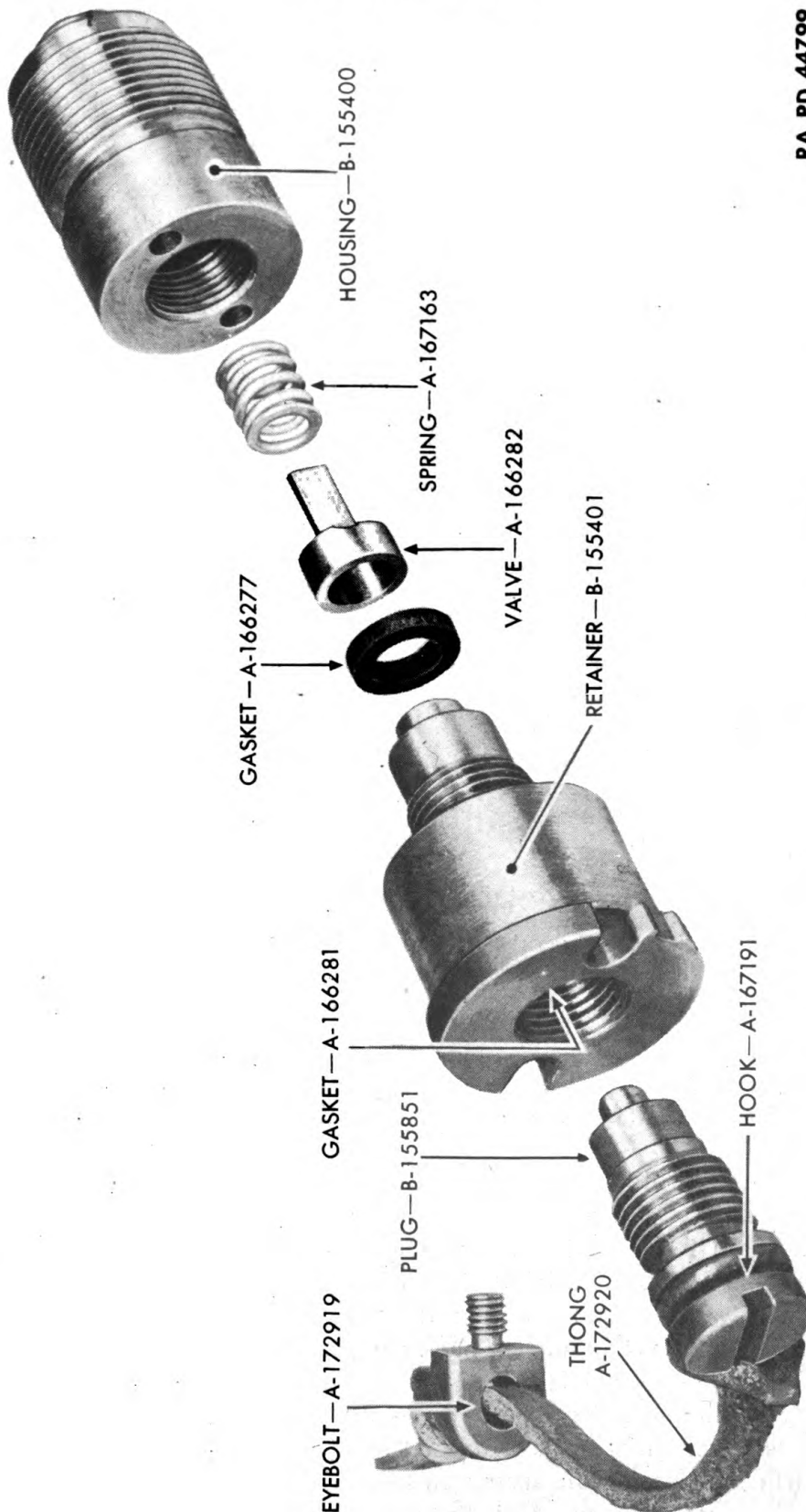


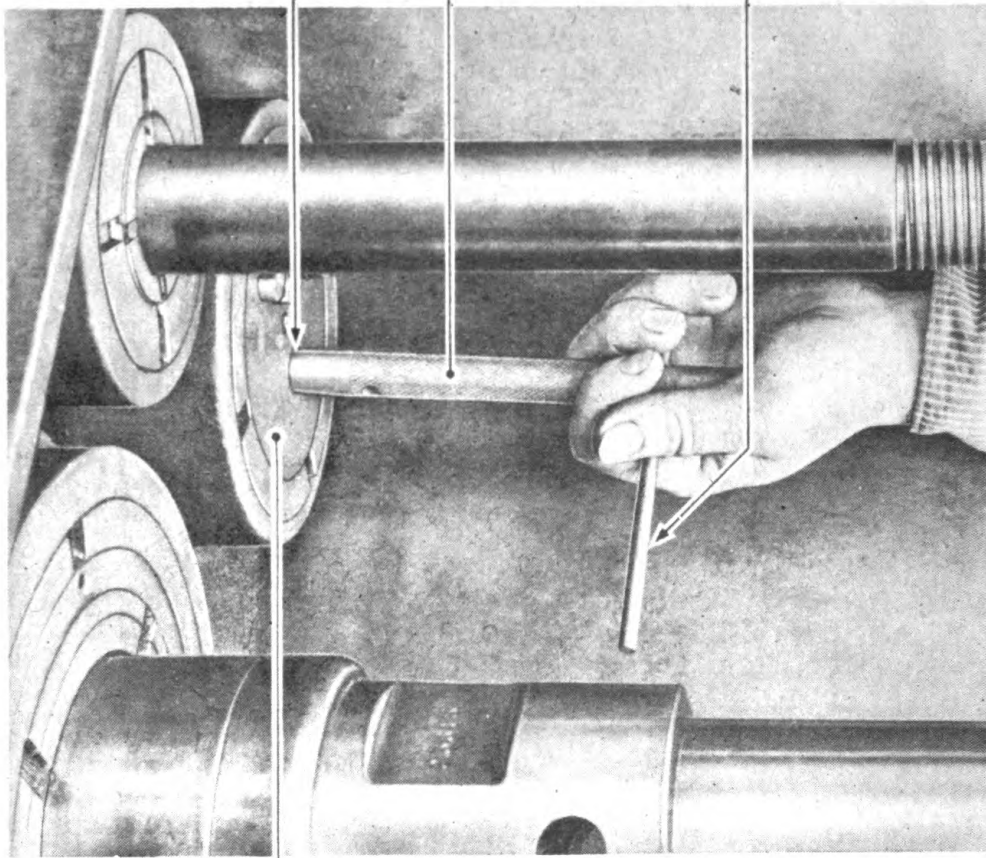
Figure 132—Oil Index Housing Filling and Drain Valve Group

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

FOLLOWER—B-155406

WRENCH—A-7488

HANDLE—A-6788



HOUSING—C-67552

RA PD 45336

Figure 133—Removing Oil Index Follower

must be toward the outside and next to the flat surface of the gland which follows. The concave surfaces of glands face convex surfaces of packings.

(5) If oil index still sticks, report failure to Chief of Ordnance.

(6) If oil index sticking is corrected, establish proper oil reserve in the system.

d. Replace Counterrecoil Rod Wiper Follower.

(1) If it is necessary to replace the counterrecoil rod wiper due to leakage of oil, proceed as follows:

(a) Remove recoil and counterrecoil piston rod yoke (subpar. a above).

(b) Remove follower A166209 (figs. 134 and 135). Wiper A158880 will come away with follower.

(c) Place new counterrecoil rod wiper in counterrecoil rod wiper follower, and install wiper and follower in the head B104967.

(d) Replace recoil and counterrecoil piston rod yoke. Refill system with oil (subpar. a above).

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RECOIL MECHANISM

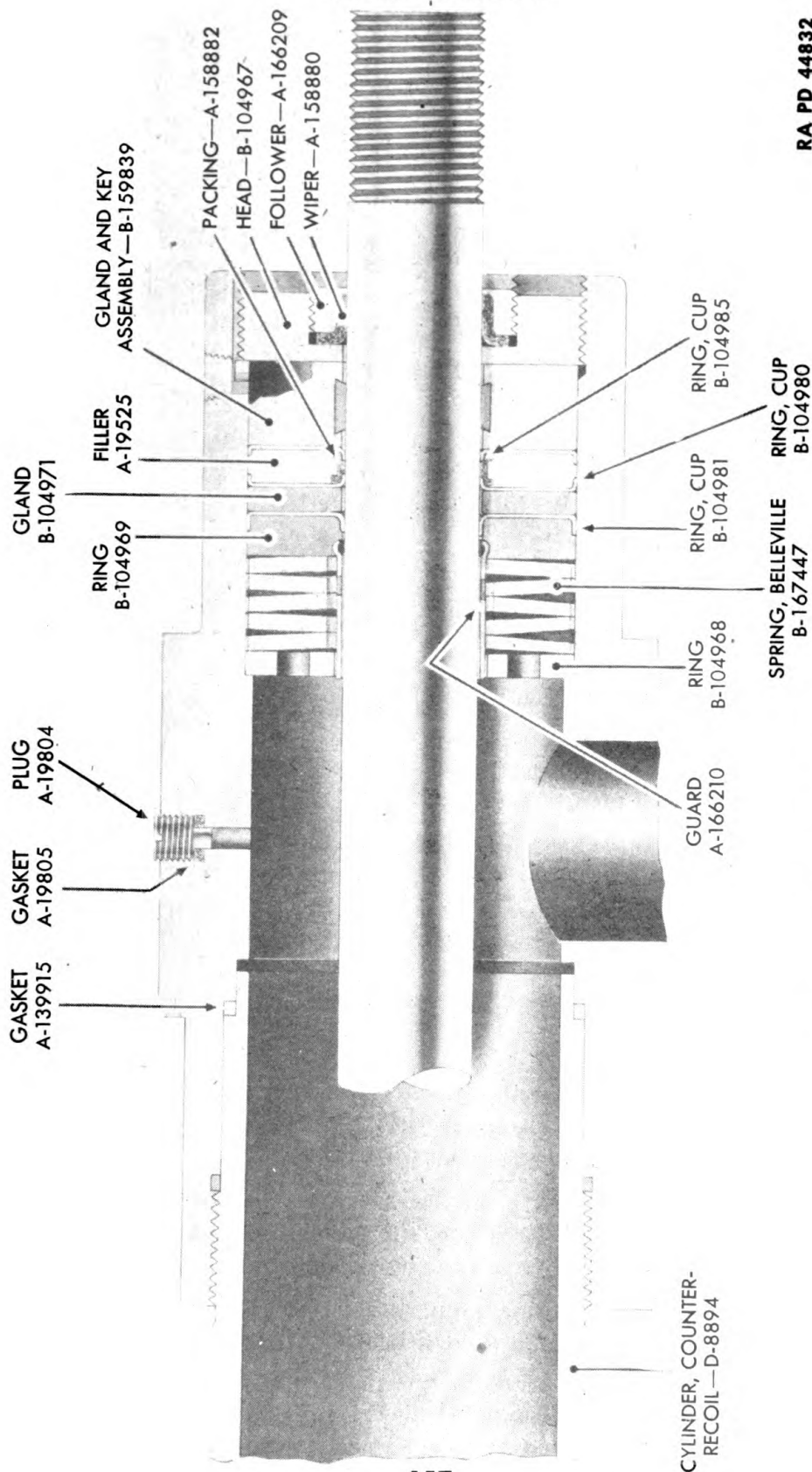
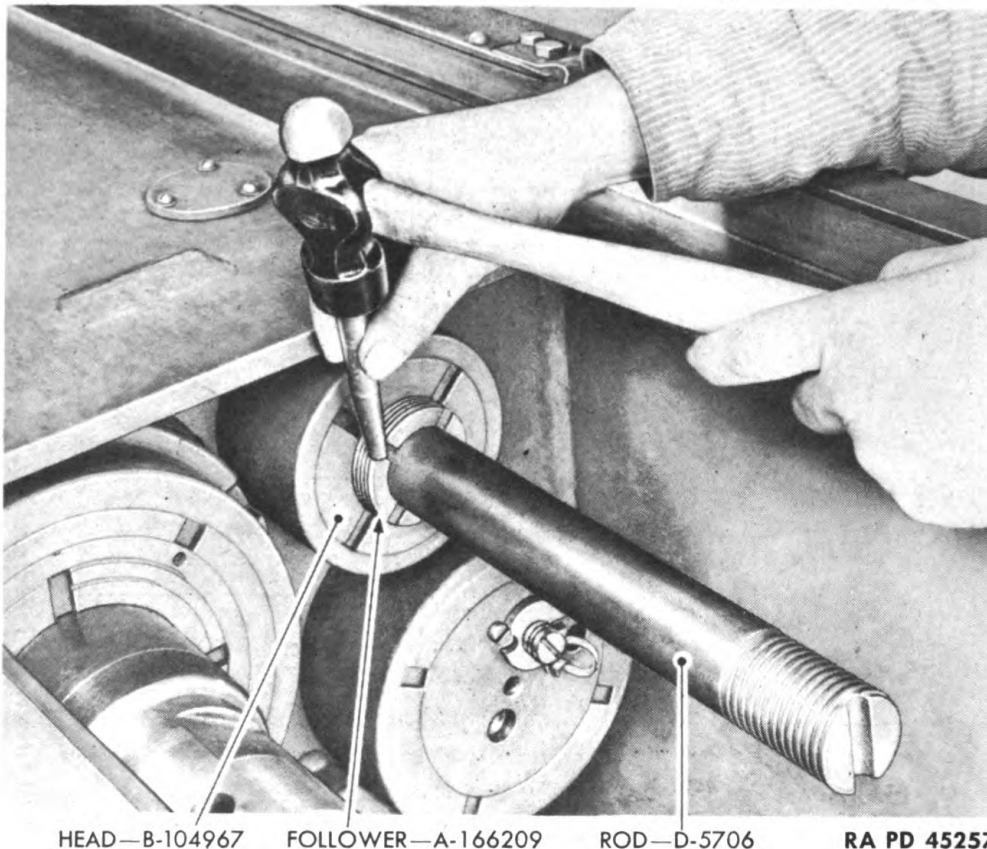


Figure 134—Counterrecoil Stuffing Box

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



HEAD—B-104967

FOLLOWER—A-166209

ROD—D-5706

RA PD 45257

Figure 135—Removing Counterrecoil Rod Wiper Follower

e. **Adjusting Counterrecoil Piston Packing.** Leakage of oil past the counterrecoil piston can frequently be corrected by the following steps:

(1) Remove safety screw BCTX1BD and unscrew head B104966 (figs. 123 and 136).

(2) Remove screw A19460 from wiper retainer B104972 (fig. 137).

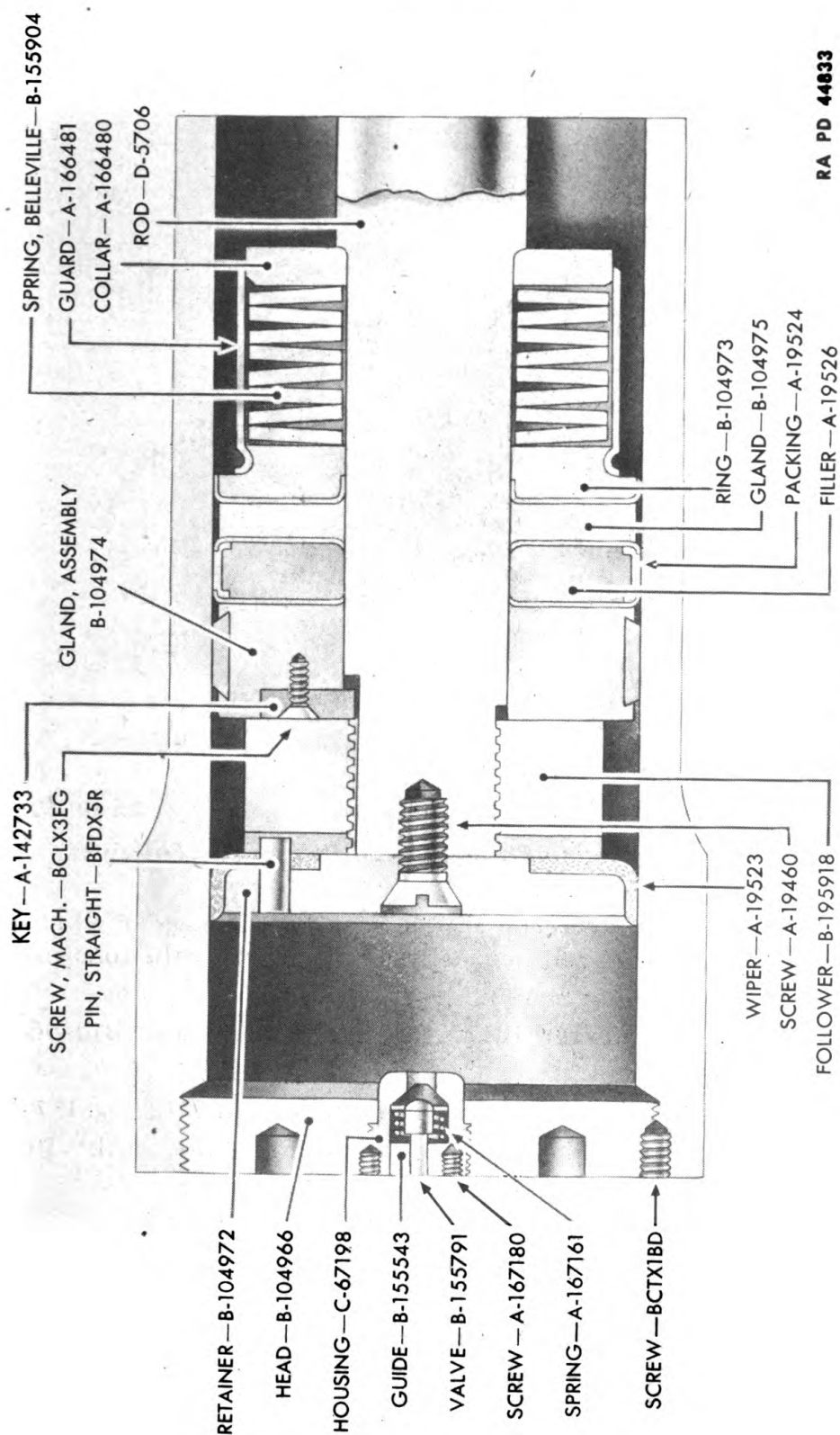
(3) Pull retainer and wiper A19523 with a wire hook. Pin BFDX5R will come out with retainer (fig. 138).

(4) Tighten the counterrecoil piston follower B195918 (figs. 136 and 139). This will compress packing A19524 and stop leakage. **NOTE:** Do not tighten too much as this will damage ring B104973.

(5) Replace wiper, retainer, pin, and screw. Stake screw in two places. Screw counterrecoil cylinder head in place and secure with safety set screw.

(6) Continuation of leakage indicates broken springs or deteriorated packing. Report the recoil mechanism to the Chief of Ordnance.

RECOIL MECHANISM



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Figure 136—Counterrecoil Piston

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

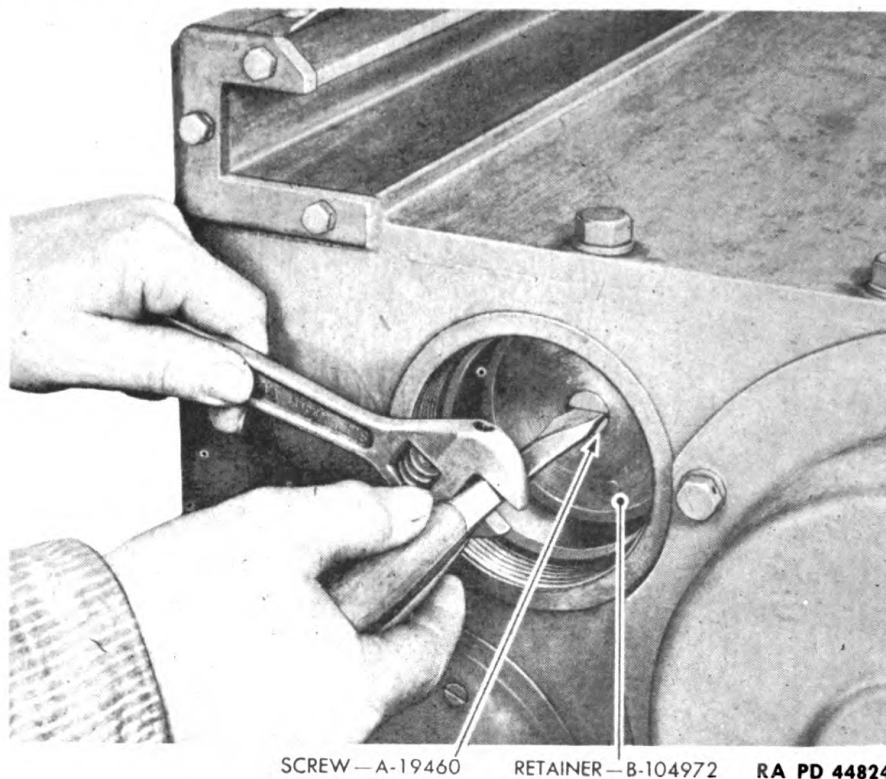


Figure 137—Removing Wiper Retainer Screw

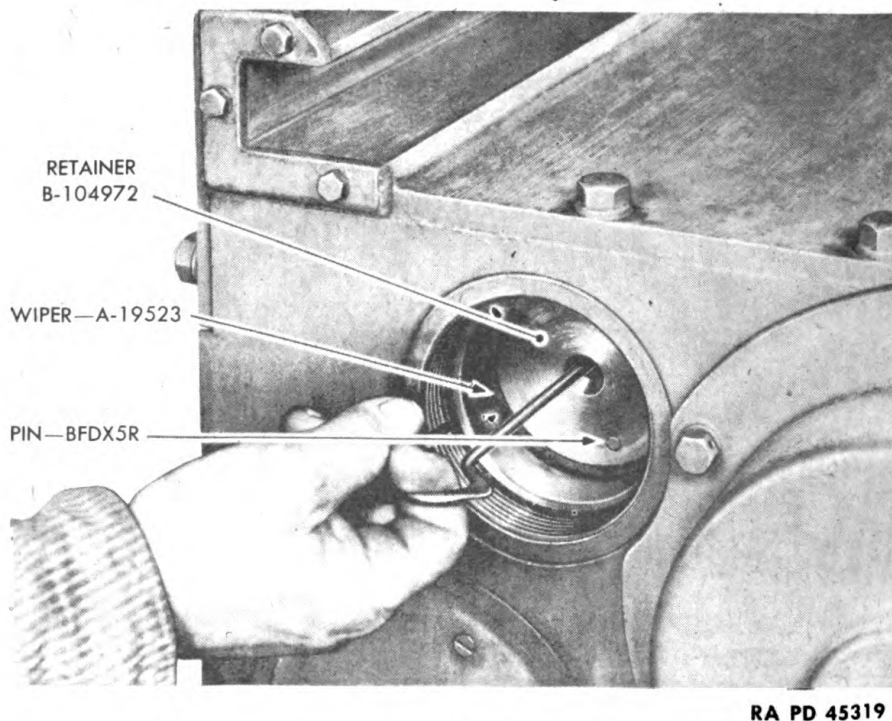
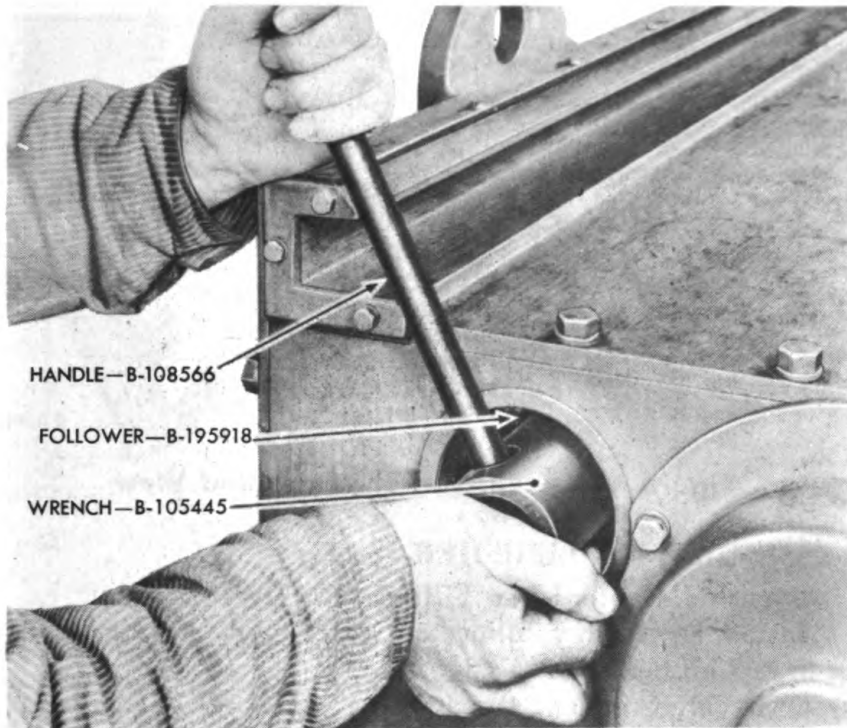


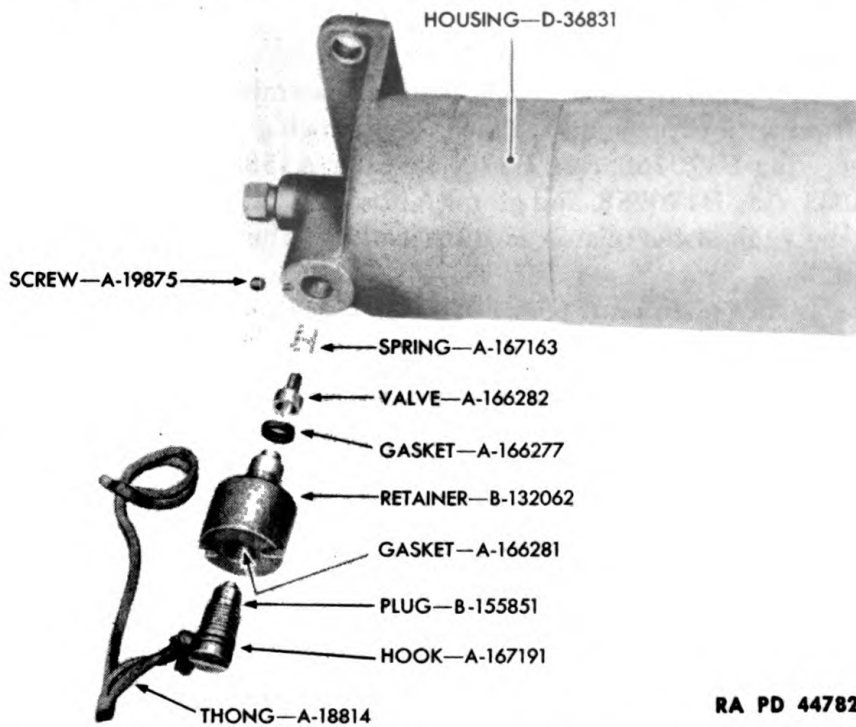
Figure 138—Removing Retainer and Wiper

RECOIL MECHANISM



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Figure 139—Adjusting Counterrecoil Piston Follower



RA PD 44782

Figure 140—Replenisher Filling Valve—Exploded View
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**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

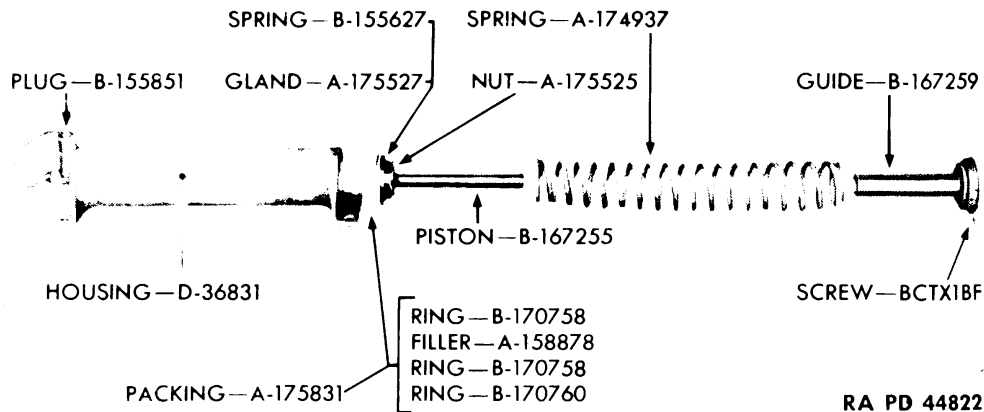


Figure 141—Replenisher—Exploded View

57. ASSEMBLE REPLENISHER.

a. Assemble Replenisher Filling and Drain Valve.

(1) Install replenisher filling and drain valve spring, valve, and gasket in replenisher housing (fig. 140).

(2) Coat valve retainer threads with COMPOUND, rust-preventive, light. Screw the valve retainer into the replenisher housing (fig. 117). Secure with retainer locking screw A19875.

(3) With gasket A166281 in the retainer, install the filling and drain plug in the retainer.

b. Assemble Replenisher Piston.

(1) If replenisher piston has been disassembled, place piston in a vise fitted with copper jaws. Place the following on the piston in order named: ring B170760, ring B170758, filler A158878 and new packing A175831, ring B170758, and gland A175527 (fig. 141). NOTE: Every time the replenisher piston is disassembled, the packing must be replaced.

(2) Install piston nut (fig. 116).

c. Carefully install piston assembly in the replenisher housing. Install piston spring and guide on piston. Screw short threaded end of replenisher piston extractor 15-5-379 tightly into end of piston. Screw the extractor nut and washer on the extractor. Compress replenisher piston spring so the replenisher piston guide can be screwed into the replenisher housing (fig. 115).

d. Tighten replenisher piston guide in the housing. Secure guide with safety set screw and remove extractor (fig. 114).

58. ASSEMBLE REPLENISHER TUBE.

a. Place the following in the order named on the replenisher tube: retainer, replenisher tube packing outer gland, two new tube packings,

RECOIL MECHANISM

RA PD 44783

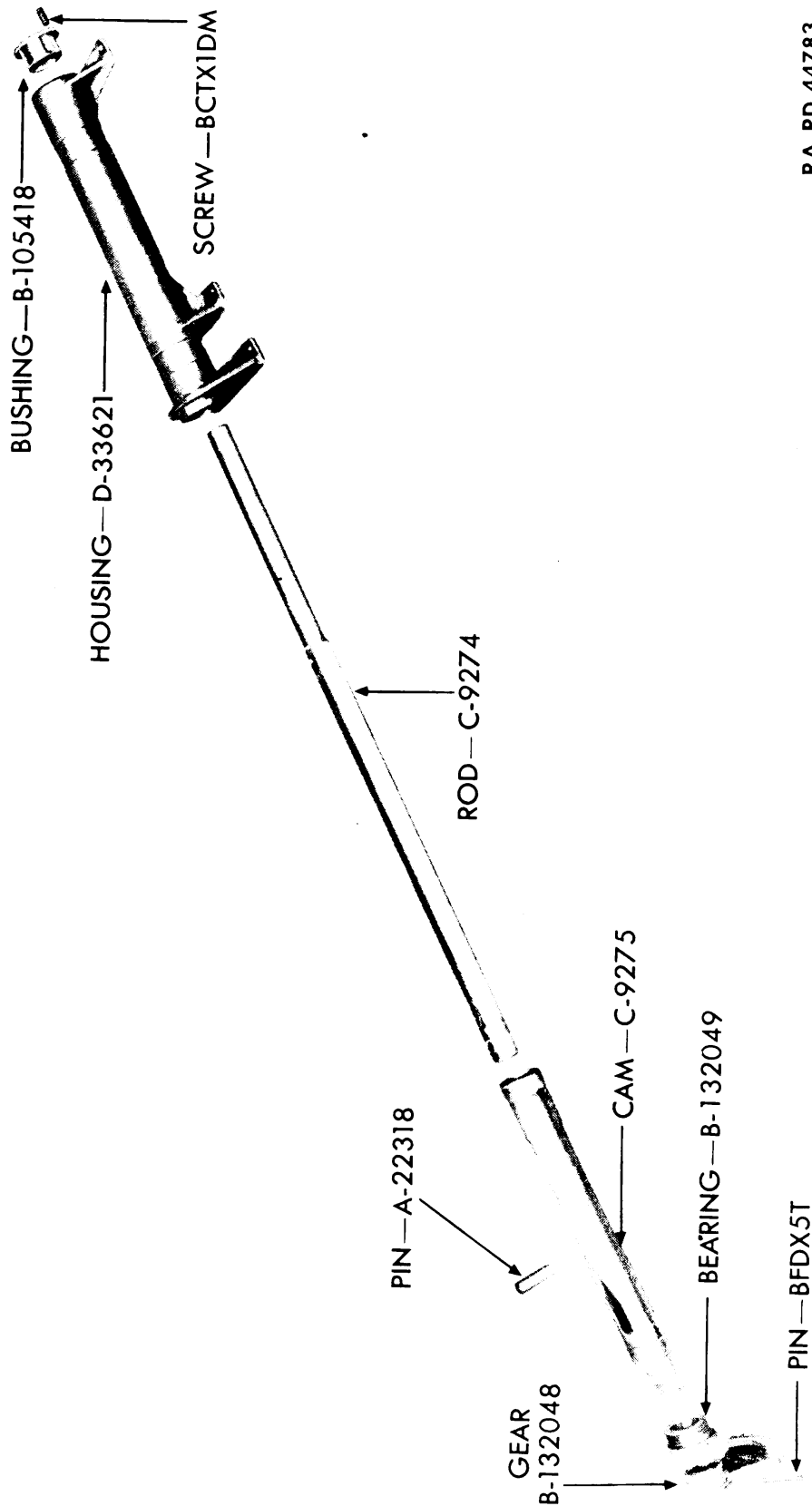


Figure 142—Variable Recoil Mechanism—Exploded View

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

replenisher tube packing inner gland, and tube collar. **NOTE:** The concave sides of the glands must face the convex side of the packings (fig. 113).

b. Pin the tube collar in place with the 0.0625- x $\frac{7}{16}$ -inch straight pin.

59. ASSEMBLE VARIABLE RECOIL MECHANISM.

a. Tap the variable recoil cam housing bushing in place in rear end of cam housing. Secure with four safety set screws (figs. 142 and 109).

b. Lubricate the cam end of the variable recoil cam turning rod with **PETROLATUM**. Apply **PETROLATUM** the full length of the squared portion. Slide the round end of the rod through the cam housing and cam housing bushing.

c. Coat the variable recoil cam with **PETROLATUM**. Slide it into place on the cam turning rod so that the variable recoil cam pin can be inserted through the cam and rod. Place more **PETROLATUM** in cam slots. Then push cam and cam turning rod back in the cam housing far enough to install the variable recoil cam bearing. Tighten the cam bearing in the front end of the cam housing (figs. 142, 110, and 111).

d. Tap the variable recoil cam gear in position on the cam. Secure with 0.250- x $2\frac{1}{4}$ -inch straight pin (fig. 108).

60. ASSEMBLE CRADLE.

a. Mount Variable Recoil Mechanism.

(1) Tap the recoil control rod gear in position on end of recoil control rod. Secure with 0.250- x 3-inch straight pin (fig. 106).

(2) Screw replenisher tube packing housing into end of recoil control rod (fig. 105).

(3) Coat the mating surfaces of cam turning rod support bracket and three cam housing brackets with **LEAD**, white. Slide bracket on end of cam turning rod. Secure bracket to cradle with two screws and washers. Secure cam housing to cradle with six screws and washers (fig. 104). **NOTE:** The two gears will be in mesh, and the lines "A" on gears will be in a straight line when properly installed (fig. 102).

(4) Install variable recoil connecting rod on cam turning rod. Line up holes in both and tap headless pin in place. Secure with two cotter pins (fig. 103).

b. Install Replenisher Tube and Packing Retainer.

(1) Install the replenisher tube and replenisher tube packing retainer in the replenisher tube packing housing (fig. 102). Tighten retainer in the housing.

(2) Secure the retainer in the housing with safety set screw.

(3) Install the variable recoil gear cover over the variable recoil

RECOIL MECHANISM

gears and the replenisher tube. Secure with two screws, washers and nuts, and six bolts and washers (fig. 101).

c. Mount Replenisher Assembly.

(1) Coat the mating surfaces of the cradle and replenisher housing brackets with **LEAD**, white. Secure the replenisher assembly to cradle with four screws and washers.

(2) Remove the cloth plug from replenisher tube and connect the replenisher tube connector to the replenisher assembly (fig. 100).

(3) Place replenisher tube guard assembly over replenisher tube and secure with four screws and washers (fig. 99).

(4) Screw adapter B158805 into replenisher valve retainer; purge the oil pump line of air and connect Oil Pump M3 to adapter. Pump **OIL**, recoil, heavy, into the replenisher. Insert the flexible steel rule B5757 through opening in replenisher guide and against the replenisher piston. Work the pump until rear end of replenisher piston is $5\frac{3}{4}$ inches from rear face of replenisher. Remove the oil pump and adapter, and install the filling and drain valve plug in the retainer.

d. Mount Elevating Arc. Coat the mating surfaces of elevating arc and cradle with **LEAD**, white. Coat the threads of elevating arc retaining bolts with **COMPOUND**, rust-preventive, light. While two men hold the elevating arc in position under the cradle, insert and tighten the four large bolts and washers (fig. 96).

e. Install Sheave Bracket and Sheave.

(1) Coat the mating surfaces of sheave bracket and cradle with **LEAD**, white. Coat threads of eight sheave bracket retaining screws with **COMPOUND**, rust-preventive, light, and secure sheave bracket to cradle (fig. 97).

(2) Install sheave and bearing assembly in the sheave bracket. Secure with sheave locking pin.

NOTE: Trunnion bearing cap assemblies are not mounted on cradle until cradle is ready to be mounted on carriage (par. 117).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

Section XV

TRAVERSING MECHANISM

	Paragraph
General	61
Malfunctions	62
Remove traversing mechanism from carriage	63
Disassemble traversing mechanism	64
Maintenance and repair of traversing mechanism	65
Assemble traversing gear mechanism	66
Mount traversing mechanism on carriage	67

61. GENERAL.

a. The traversing mechanism is mounted on the left side of the top carriage (fig. 143) and rotates the gun or howitzer in azimuth by means of a pinion which meshes with the traversing arc. The traversing arc is secured to the top of the bottom carriage on the left side. The traversing handwheel shaft is connected, through a flexible joint, to a worm which drives a worm wheel and pinion which meshes with the traversing arc. The worm and worm wheel operate on anti-friction bearings in a housing, sealed to retain the lubricant and exclude dust and dirt.

b. The traversing mechanism was designed for easy operation. Binding, "hard spots," or backlash in the handwheel demand inspection to locate the source of trouble. Proper steps for correction should be taken.

c. The traversing mechanism can be removed from the carriage for repairs without removing any other part of the carriage.

62. MALFUNCTIONS.

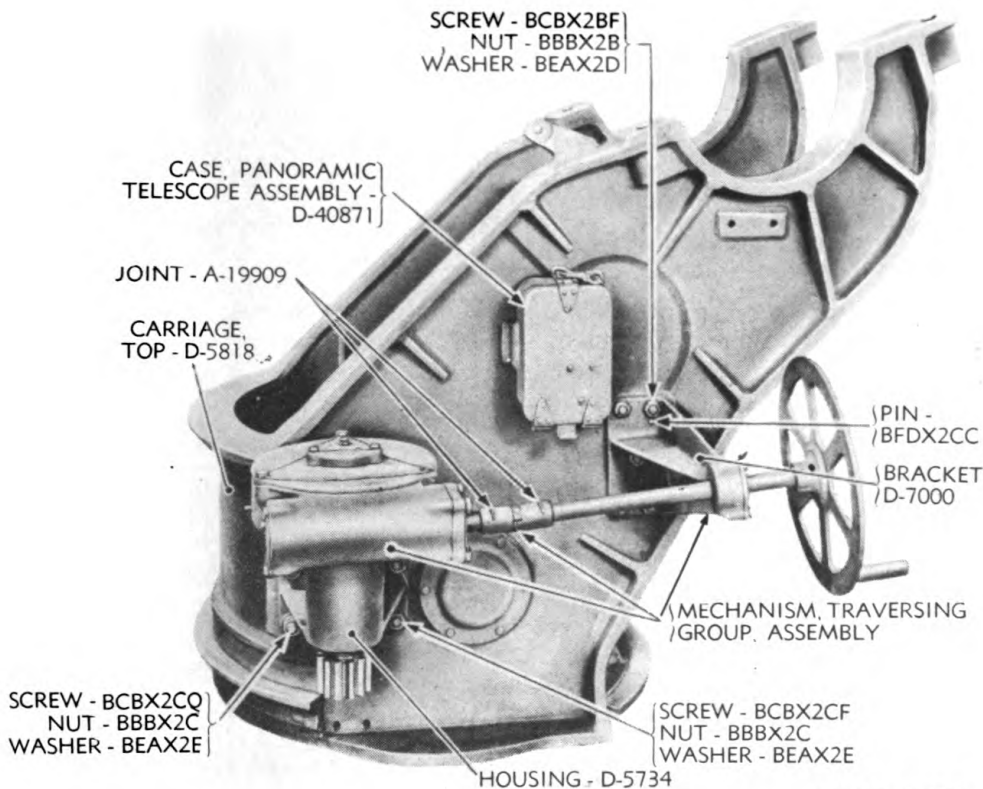
a. Difficult to Traverse.

Cause	Correction
Binding of pinion in arc caused by misalignment of worm and worm wheel; worn or damaged pintle bushing, or pintle bearing; loose pintle; or damaged traversing handwheel shaft bracket bearing.	Inspect for trouble, disassemble, and repair (par. 65). For repair of pintle, see paragraphs 76 and 78.

b. Backlash in Excess of One-sixth Turn of Handwheel.

Worn worm or worm wheel, or both. Worn pinion or arc, or both.	Check for source of trouble and repair (par. 65).
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TRAVERSING MECHANISM



RA PD 79975

Figure 143—Top Carriage and Traversing Mechanism**63. REMOVE TRAVERSING MECHANISM FROM CARRIAGE.****a. Remove Traversing Arc and Stops.**

(1) Remove two screws BCAX1AB and washers BEAX1H from each traversing arc stop and remove both stops (fig. 144). **NOTE:** The traversing arc can be removed from the bottom carriage with stops attached if desired.

(2) Remove eight screws BCBX1EF, eight nuts BBBX1E, nine washers BEAX2B, and one screw BCDX1BD marked "A" (fig. 145). Remove arc C7242 from bottom carriage. Screw BCDX1BD is a fillister-head screw that is countersunk in the traversing arc opposite the trail hinge pin. Three pins BFDX5.1U will come away with the arc.

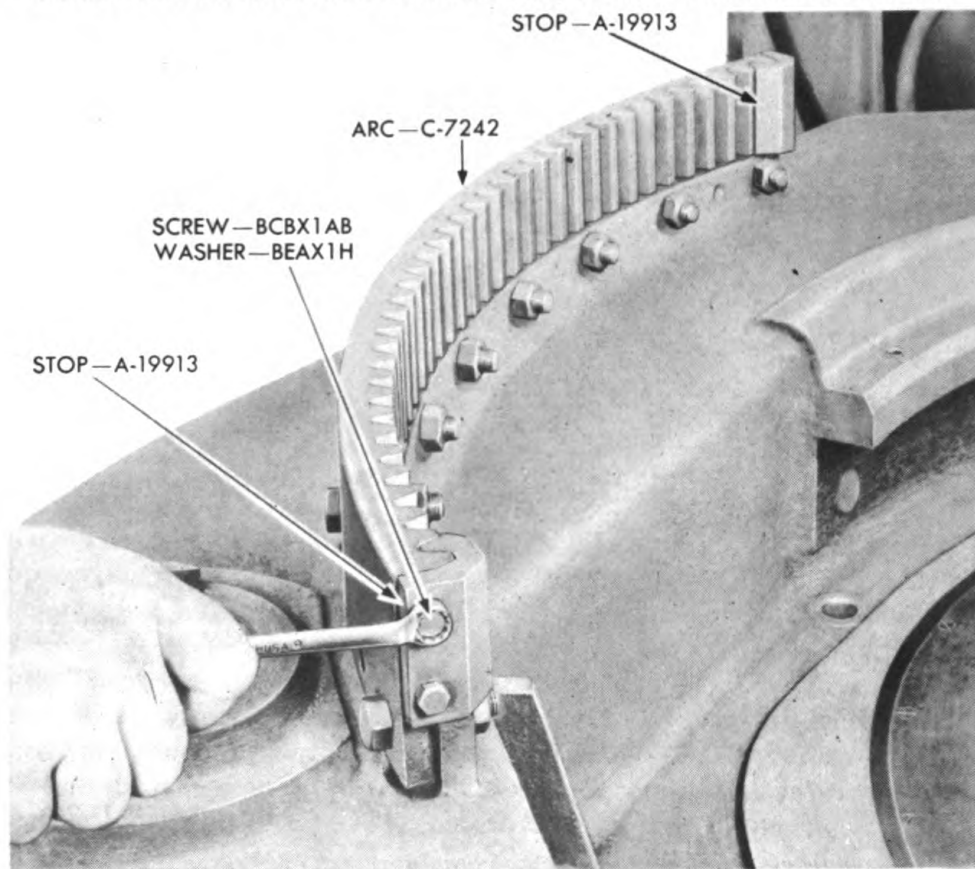
b. Remove Traversing Handwheel, Bracket and Shaft Group.

(1) Remove the two cotter pins BFAX1EM from joint A19909 (fig. 143).

(2) Remove five screws BCBX2BF, nuts BBBX2B, and washers BEAX2D from bracket D7000 (fig. 143).

(3) Remove bracket D7000 and shaft B105184 from top carriage as a unit. Two pins BFDX2CC will come away with the bracket. Joint A19909 may come away on shaft B105184 or remain on worm. In either case tap joint off (fig. 146).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44524

Figure 144—Removing Stop from Traversing Arc

c. Remove Traversing Gear Housing Assembly.

(1) Remove six nuts BBBX2C and washers BEAX2E from screws BCBX2CF and BCBX2CQ (figs. 143 and 147). Do not remove screws. Use a heavy screwdriver to keep nuts on the top two screws from turning while unscrewing screws.

(2) Two men should lift the housing D5734 assembly away from the top carriage. **NOTE:** It may be necessary to tap the housing lightly to break it loose from the key slot in the top carriage (fig. 148).

(3) Tap six screws out of top carriage.

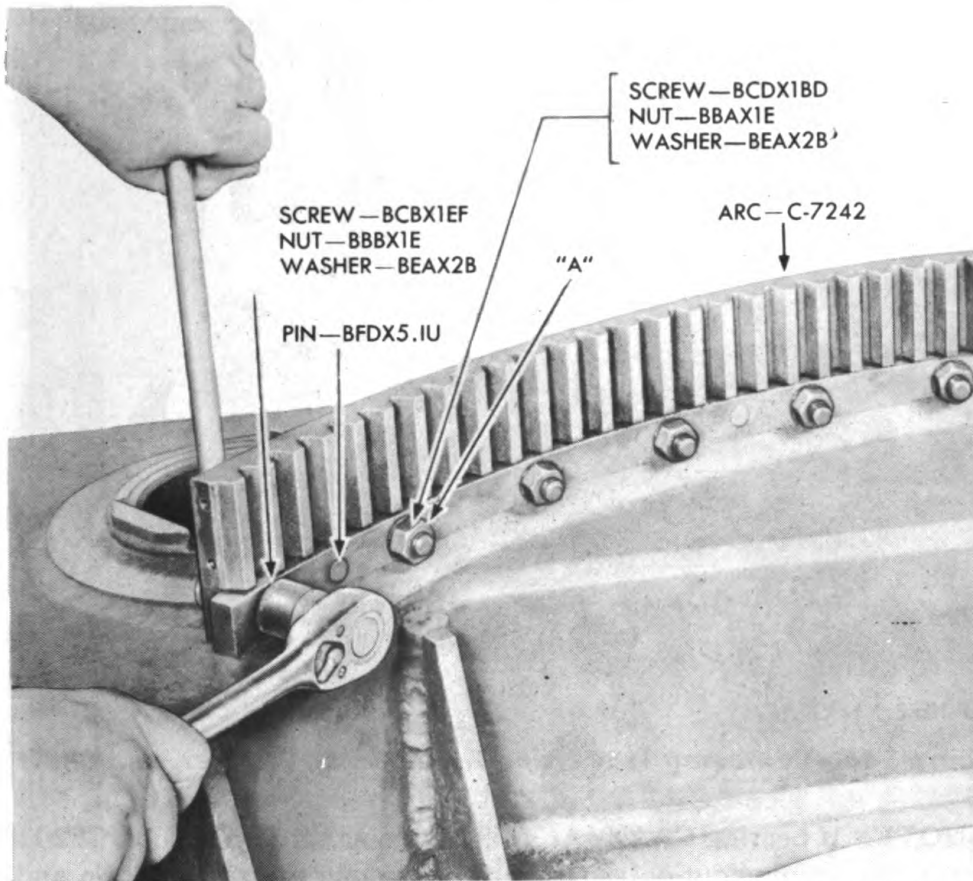
64. DISASSEMBLE TRAVERSING MECHANISM.

a. Disassemble Traversing Handwheel, Bracket, and Shaft (fig. 149).

(1) Remove nut BBDX2C and washer BEAX2E from shaft B105184. Tap handwheel C7266 from shaft and remove key BGHX1NE from shaft.

(2) Remove three screws BCAX1CB and washers BEAX1L from cover B105188 and bracket D7000. Slide cover from shaft.

TRAVERSING MECHANISM



RA PD 44525

Figure 145—Removing Traversing Arc

(3) Remove shaft B105184 and bearing CAEX4AG from bracket D7000. It may be necessary to tap these loose from bracket with a copper hammer.

(4) Place shaft and bearing in a vise fitted with copper jaws and lightly tap shaft B105184 down out of bearing CAEX4AG.

b. Disassemble Traversing Gear Mechanism Assembly.

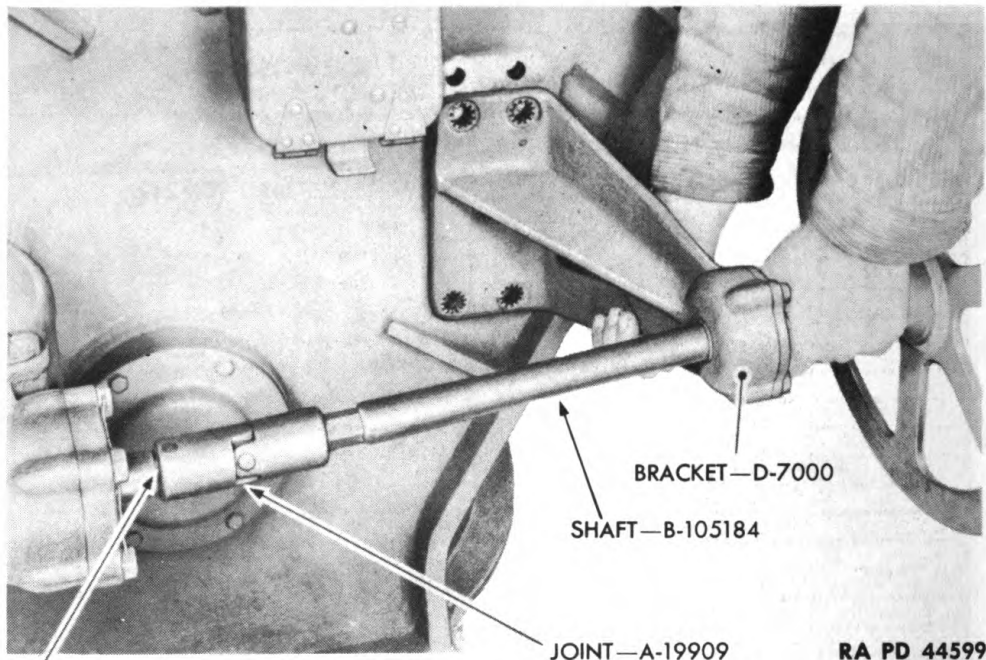
(1) Remove pipe plug CPMX1AA from housing and drain the oil into a suitable container. Screw plug back in after draining so it will not be lost.

(2) Remove safety wire BFWX1A and three screws BCAX4AE from cover B105010 (fig. 150). Remove cover.

(3) Straighten lug on washer BEFX1AK. Remove nut BBRX1AK with traversing worm wheel nut socket wrench B105326. Remove washer (fig. 156).

(4) Remove safety wire BFWX1C and three screws BCAX4L from cover C7180. Lift cover from housing D5734. Bearing CAAX3AK comes away in cover (fig. 156).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



TAP HERE IF NECESSARY

Figure 146—Removing Traversing Handwheel, Bracket, and Shaft

NOTE: If bearing CAAX3AK will not come off from pinion C7201 easily, drive pinion out of bearing with a hammer and wood block, and remove cover C7180 with bearing CAAX3AK.

(5) Remove pinion C7201 from housing D5734. Bearing CAAX3AL and seal A171717 will come away on pinion (fig. 156).

(6) Remove safety wire BFWX1A and three screws BCAX4E and lift cover B105011 from housing D5734 (fig. 151).

(7) Straighten lug on washer BEFX1AH and remove nut BBRX1AH and washer (fig. 152).

(8) Remove safety wire BFWX1B and four screws BCAX4S. Lift cover B105009 from housing D5734 (fig. 153).

(9) Straighten lug on washer BEFX1AH (fig. 156). Remove nut BBRX1AH with traversing worm nut socket wrench B105313 and handle B108566.

(10) Turn worm C7205, and while turning, force worm and bearing CAAX3AH out through rear of housing D5734 (fig. 154). Lift worm wheel C7204 from housing.

(11) Remove bearing CABX3AH from housing D5734 (fig. 156).

(12) If necessary, place cover C7180 with outside face down on two wood blocks, 2 x 4 x 6 inches (fig. 155) and remove bearing CAAX3AK from cover C7180 using wood block, 1½ x 2½ x 3½ inches, and hammer.

TRAVERSING MECHANISM

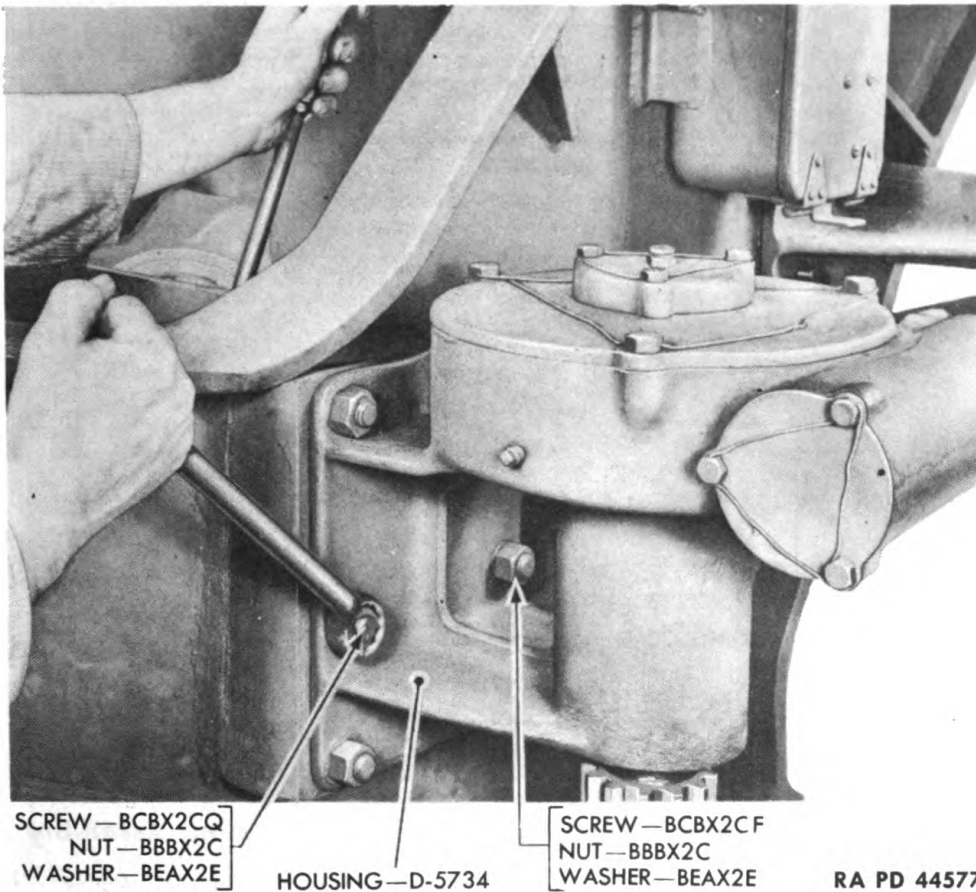


Figure 147—Removing Traversing Gear Housing Screw Nuts

(13) If necessary, remove bearing CAAX3AL and seal A171717 from pinion C7201 by placing pinion in an arbor press.

65. MAINTENANCE AND REPAIR OF TRAVERSING MECHANISM.

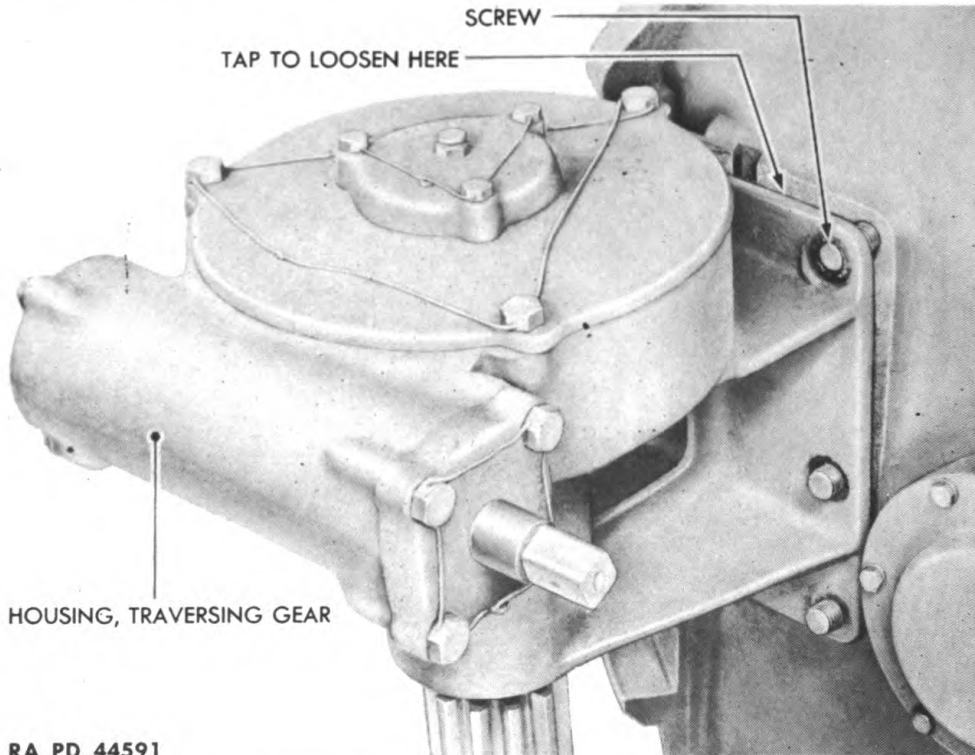
- a. Clean all parts thoroughly in SOLVENT, dry-cleaning.
- b. Examine all parts for wear and damage.
- c. Replace all worn or damaged parts.
- d. The following parts are subject to wear when not properly lubricated: Worm, worm wheel, pinion and arc teeth, and all bearings.
- e. Burred or bruised arc, pinion, worm, and worm wheel teeth should be repaired with a smooth file and polished with CLOTH, crocus. Clean thoroughly in SOLVENT, dry-cleaning. File only enough metal away to remove bur or bruise.

66. ASSEMBLE TRAVERSING GEAR MECHANISM.

- a. Assemble Traversing Gear Housing.

(1) Press the seal A171717 (open leather edge away from pinion) and single row ball bearing CAAX3AL in position on the traversing

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44591

Figure 148—Removing Traversing Gear Housing Assembly

worm wheel pinion (fig. 156). Pack the bearing with **GREASE**, general purpose (seasonal grade), working grease well into balls and races. Coat the pinion shaft and splines with grease. Insert the pinion, seal, and bearing through the traversing gear housing until the bearing **CAAX3AL** is seated.

(2) Coat the mating surfaces of the worm wheel with **GREASE**, general purpose (seasonal grade). Assemble the worm wheel on the splined end of the traversing worm wheel pinion, taking care that the seal **A171717** is not forced through the housing.

(3) Coat bearing seat of traversing gear housing with grease and insert traversing worm through the rear end of housing.

(4) Pack the traversing worm front and rear ball bearings with grease, working grease well into the balls and races. Install the front and rear ball bearings on the worm.

(5) Insert a small brass drift wrapped in clean cloth between worm and wheel to prevent worm from turning (fig. 157). Place the front bearing lock washer in position on worm shaft with lock washer lugs inclined outward. Follow with bearing lock nut with tapered side toward lock washer. Line up one lug of lock washer with slot in lock nut after nut is tightened. Bend lug into slot to lock the nut. Install the rear bearing lock washer and lock nut in the same manner. Remove

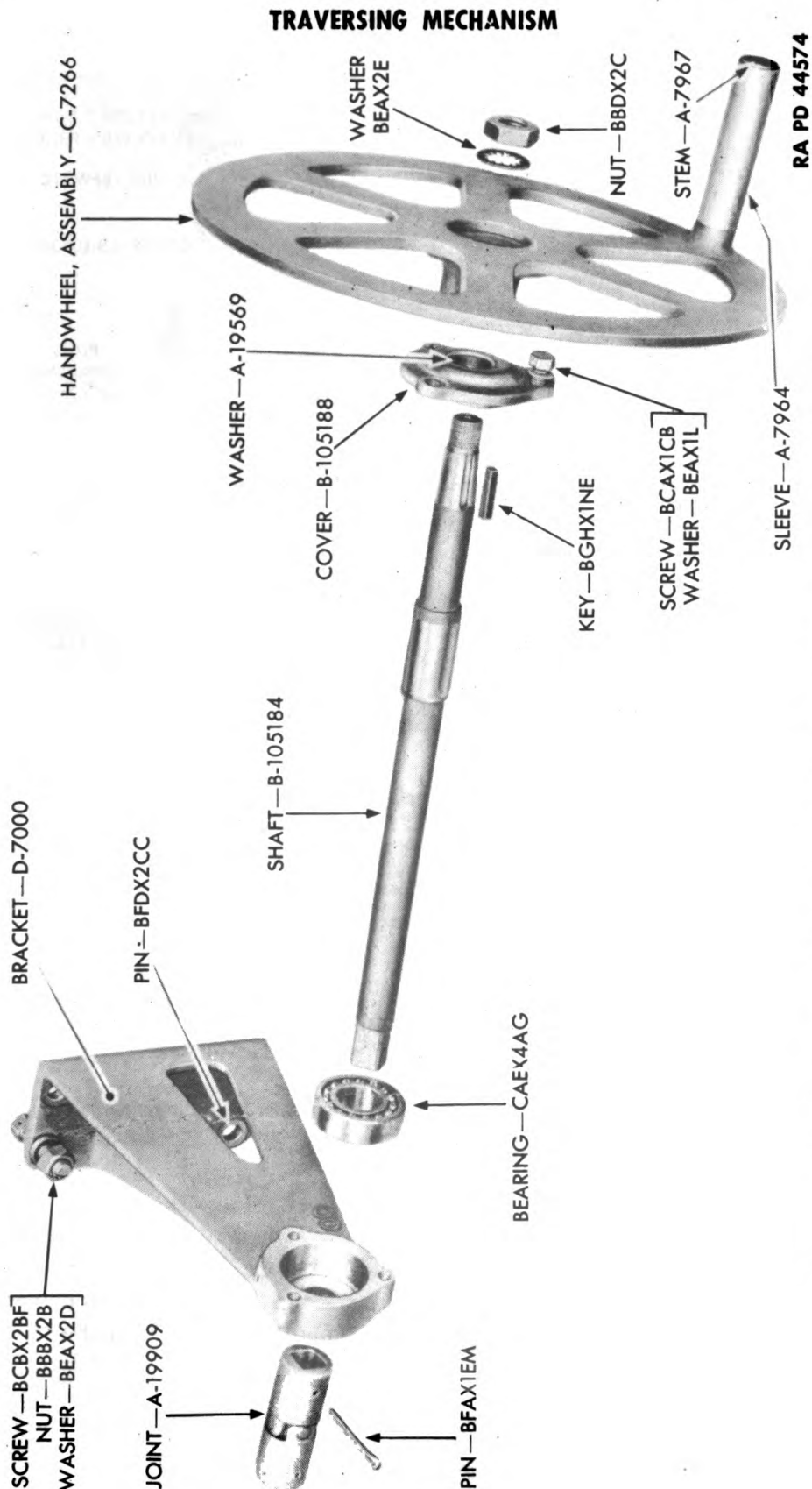


Figure 149—Traversing Handwheel, Bracket, and Shaft—Exploded View

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

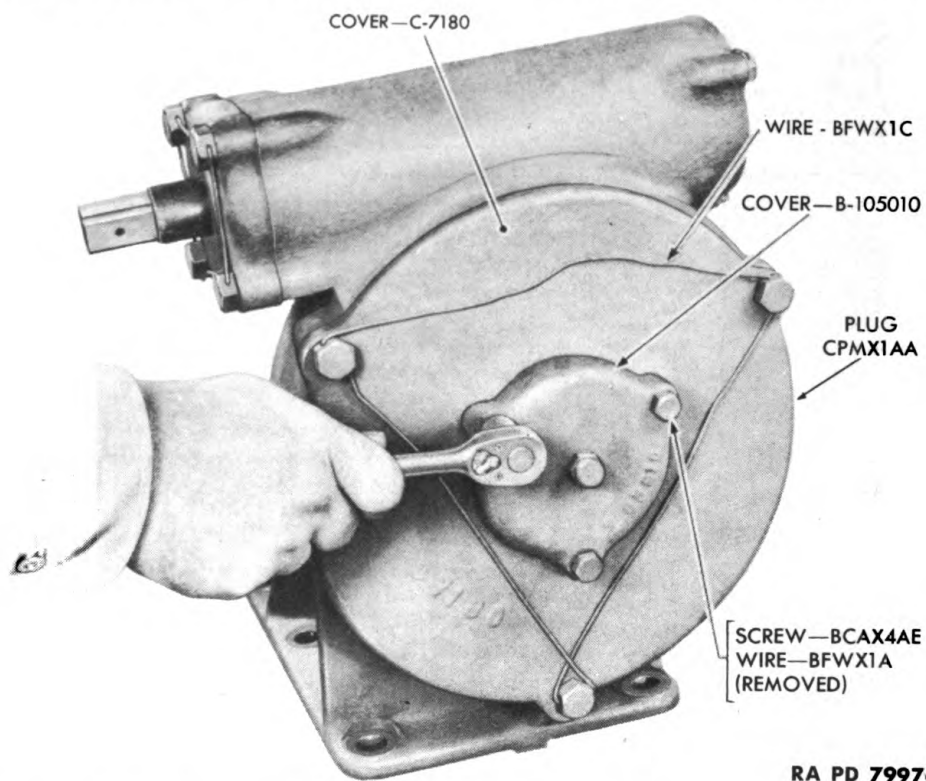


Figure 150—Removing Pinion End Cover from Housing Cover

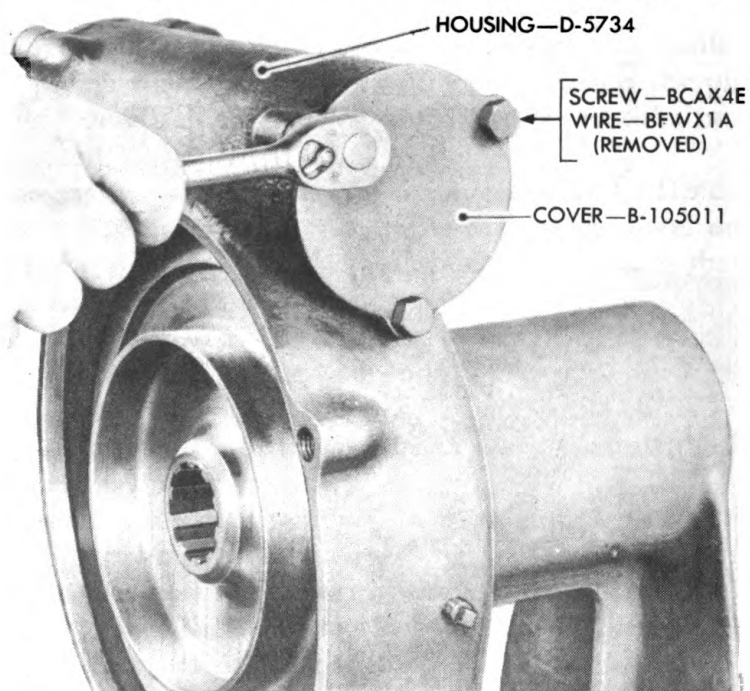
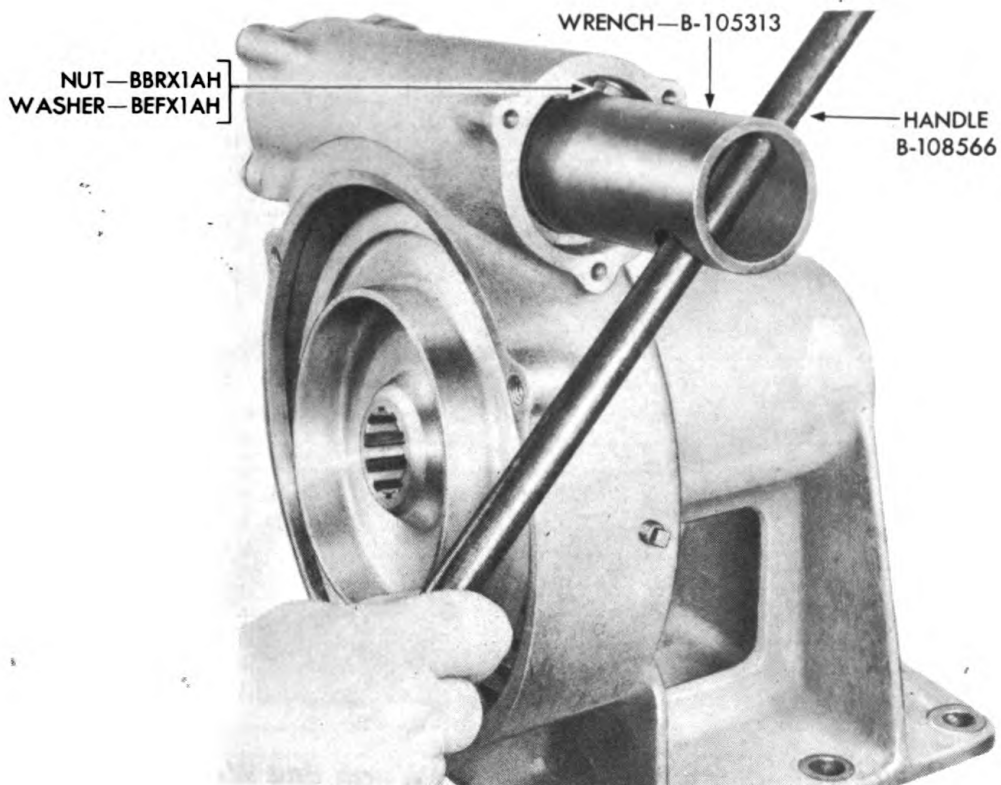


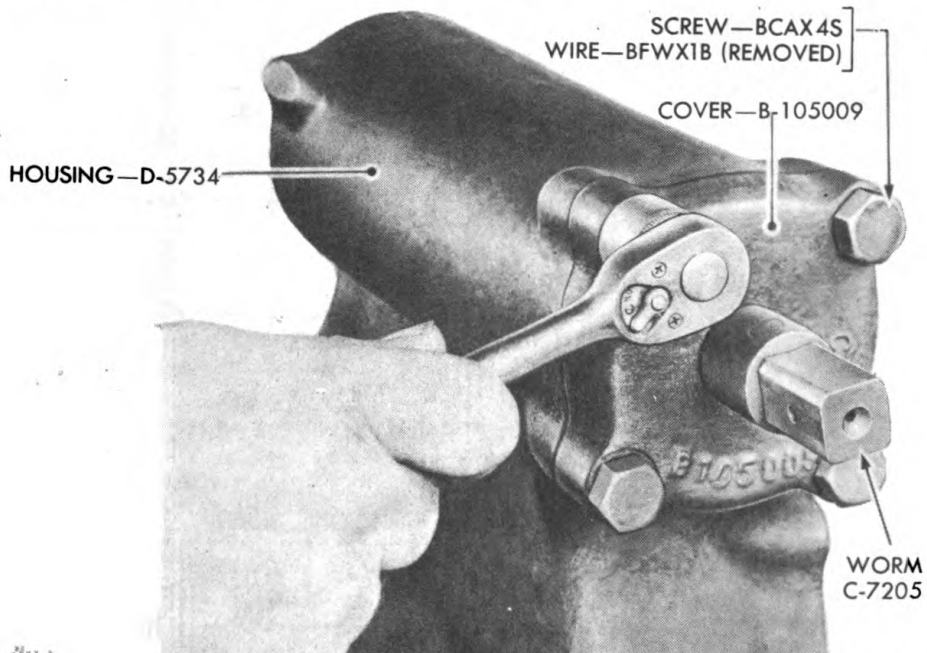
Figure 151—Removing Traversing Worm End Cover

TRAVERSING MECHANISM



RA PD 44600

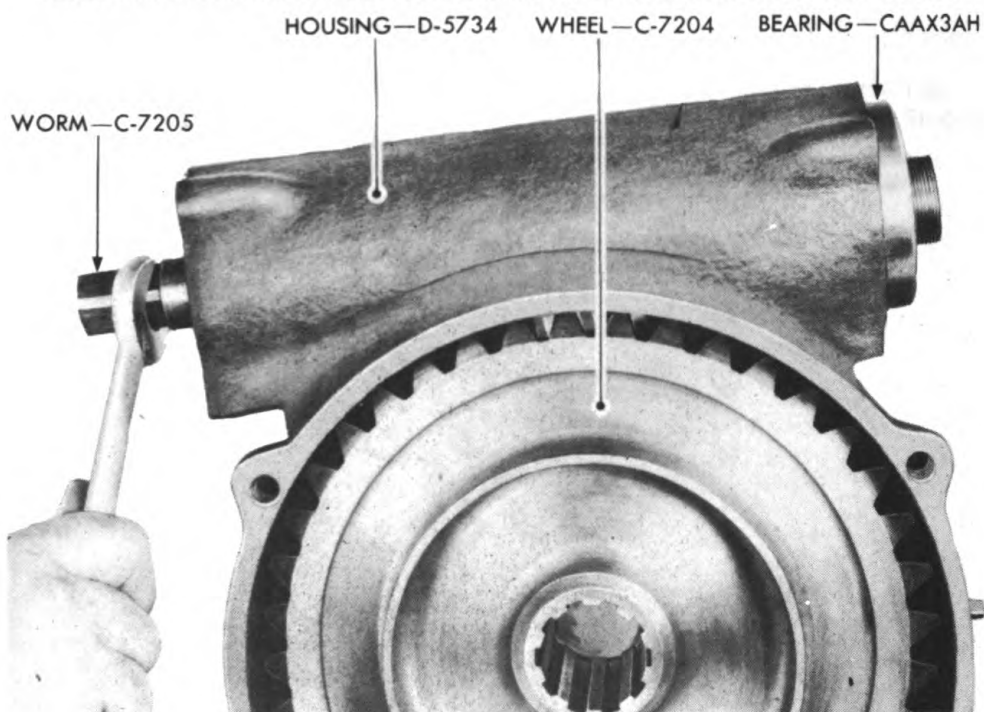
Figure 152—Removing Traversing Worm Rear Lock Nut



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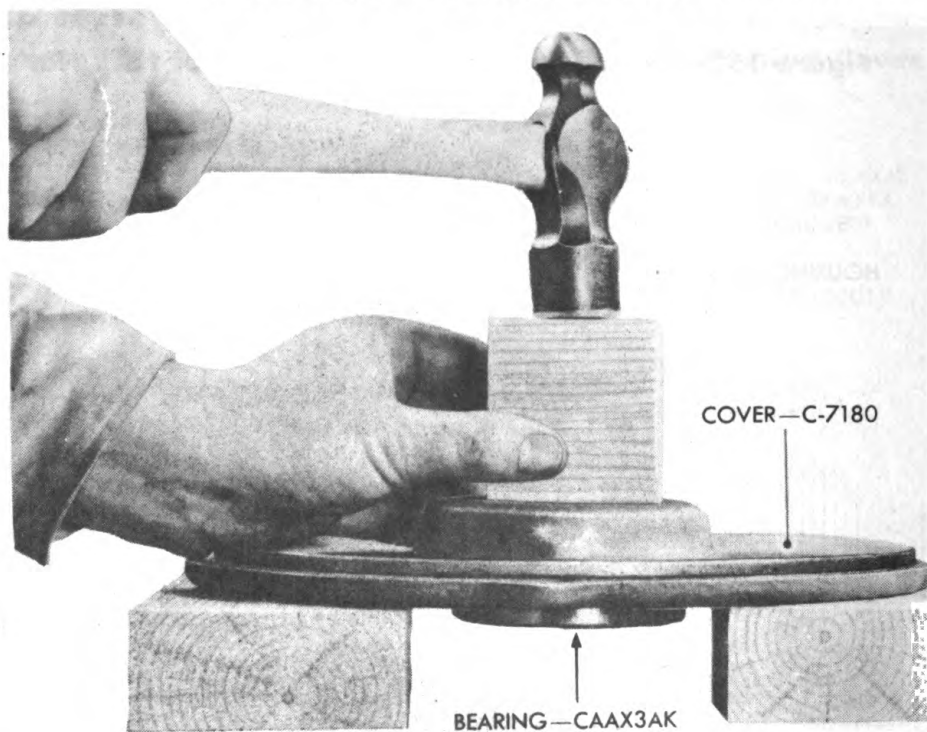
Figure 153—Removing Traversing Worm Bearing Cover

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44728

Figure 154—Removing Traversing Worm and Worm Wheel



RA PD 44596

**Figure 155—Removing Bearing from Traversing Gear Housing
Cover**

TRAVERSING MECHANISM

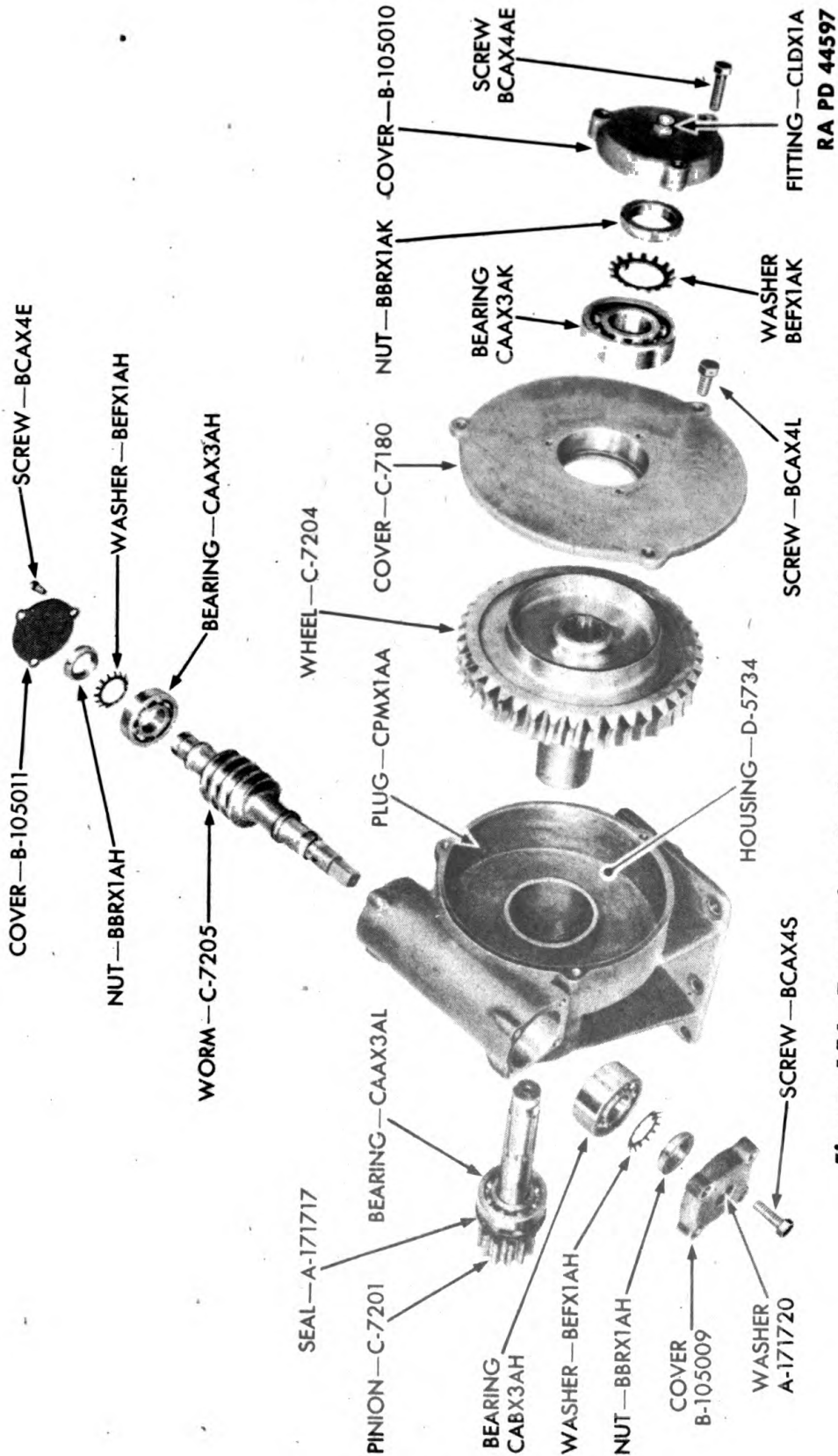


Figure 156—Traversing Mechanism Assembly—Exploded View

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

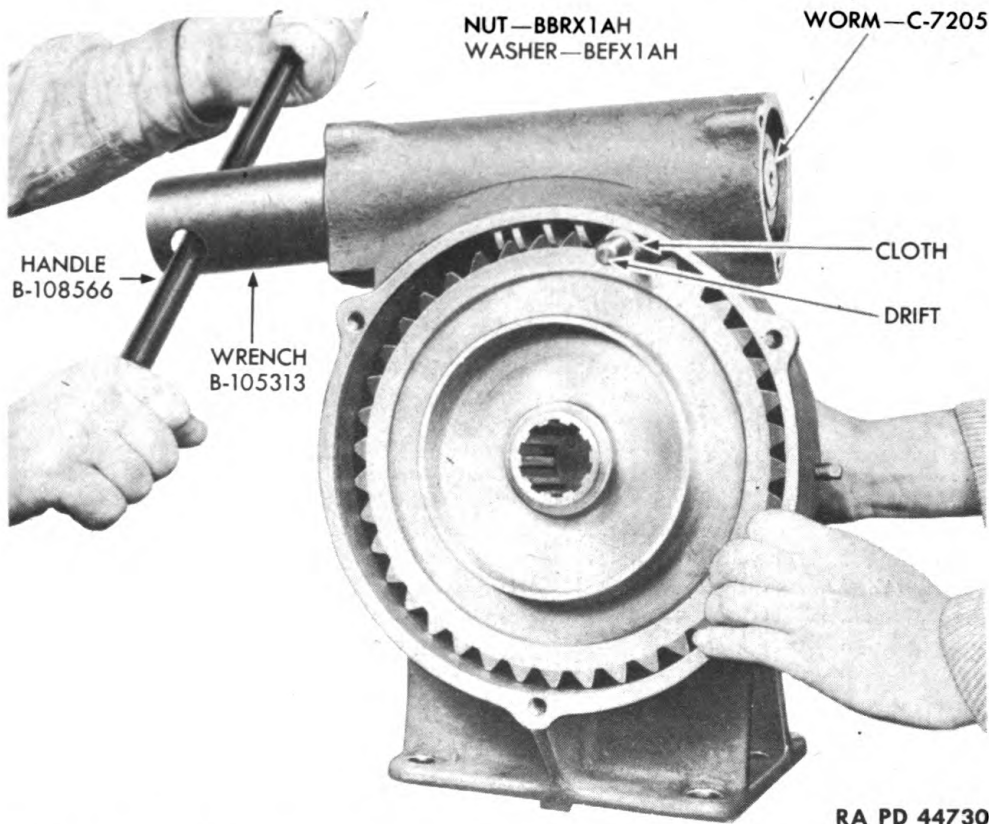


Figure 157—Installing Traversing Worm Front Bearing Lock Nut

brass drift and cloth. It may be necessary to use an $\frac{11}{16}$ -inch open-end wrench to turn the worm and wheel to release drift and cloth.

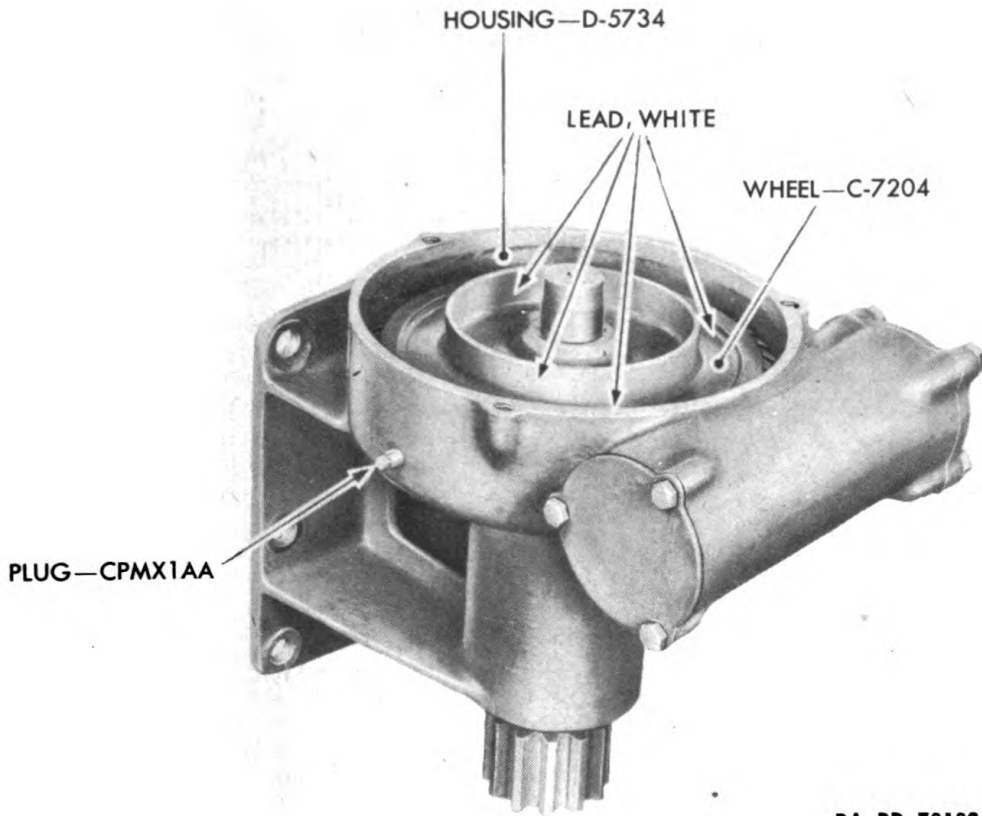
(6) Coat the mating surfaces of the traversing worm bearing cover B105009 with LEAD, white, and secure cover to traversing gear housing with screws. Coat the mating surfaces of the traversing worm and cover B105011 with LEAD, white, and secure cover to traversing gear housing with screws. Tighten screws but do not safety-wire the screws at this time.

(7) Paint the outward surfaces of worm wheel and mating surfaces of traversing gear housing with LEAD, white (fig. 158). Pour OIL, engine (seasonal grade), into traversing gear housing until oil is level with pipe plug CPMX1AA.

(8) Support the traversing gear housing at the worm portion with a wood block so that pinion will not interfere with turning the worm and worm wheel. Try the action of worm and worm wheel by turning worm (fig. 159). If tight, tap end of worm lightly with a copper hammer. Test again. The action must be free without lost motion between worm and worm wheel.

(9) Paint the mating surfaces of traversing gear housing cover

TRAVERSING MECHANISM



RA PD 73182

Figure 158—Traversing Gear Housing

C7180 with LEAD, white. Install the cover on the housing with three screws. Tighten screws but do not safety-wire them until later.

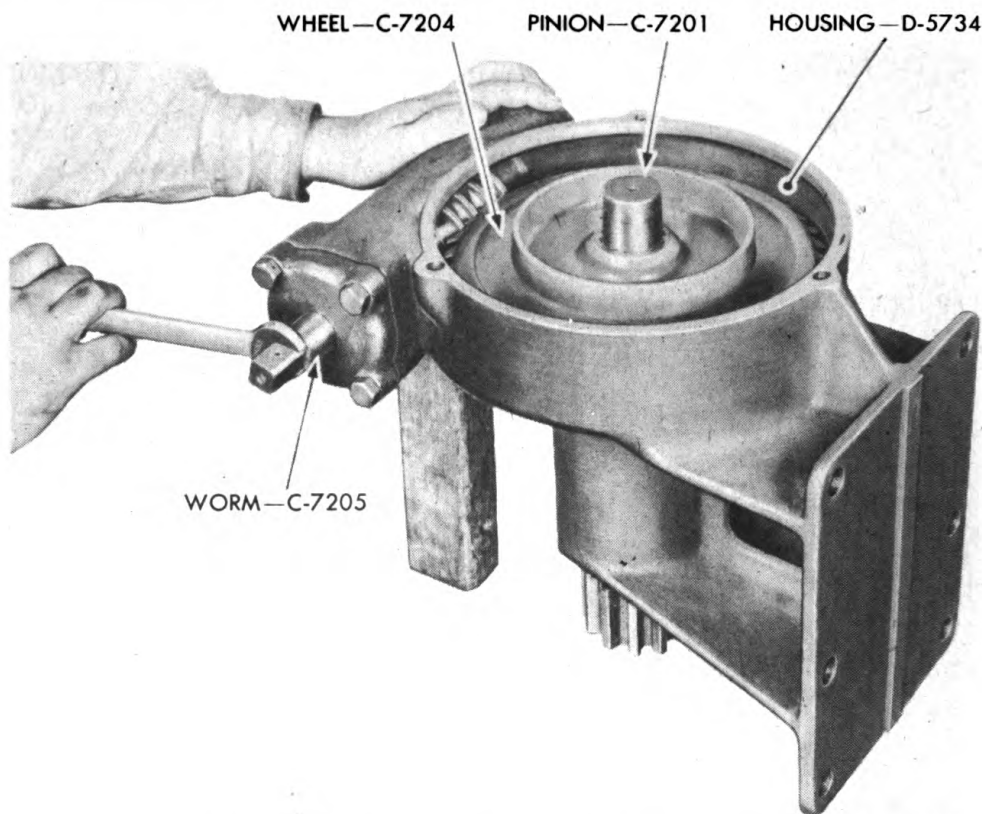
(10) Pack the ball bearing CAAX3AK with grease, working grease well into balls and races. Coat bearing seat in cover C7180 with grease. Tap the bearing into place on worm wheel pinion and in cover (fig. 160).

(11) Install pinion lock washer BEFX1AK and nut BBRX1AK on pinion. The lugs of the lock washer must incline outward and the tapered side of the lock nut must face toward the lock washer. Tighten lock nut with traversing worm nut socket wrench B105313. Line up one lug of washer with slot in nut and bend lug down into slot.

(12) Paint mating surfaces of traversing gear housing cover and traversing worm wheel pinion end cover with LEAD, white. Pack the pinion end cover with grease and secure to traversing gear housing cover with three screws. Do not safety-wire screws yet.

(13) If a new worm wheel or worm or both have been installed, the traversing gear mechanism should be checked for smooth action before mounting on top carriage. This can be done in the following manner: Place a reversible air drill in a vise fitted with copper jaws.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 45080

Figure 159—Checking Action of Worm Wheel and Worm

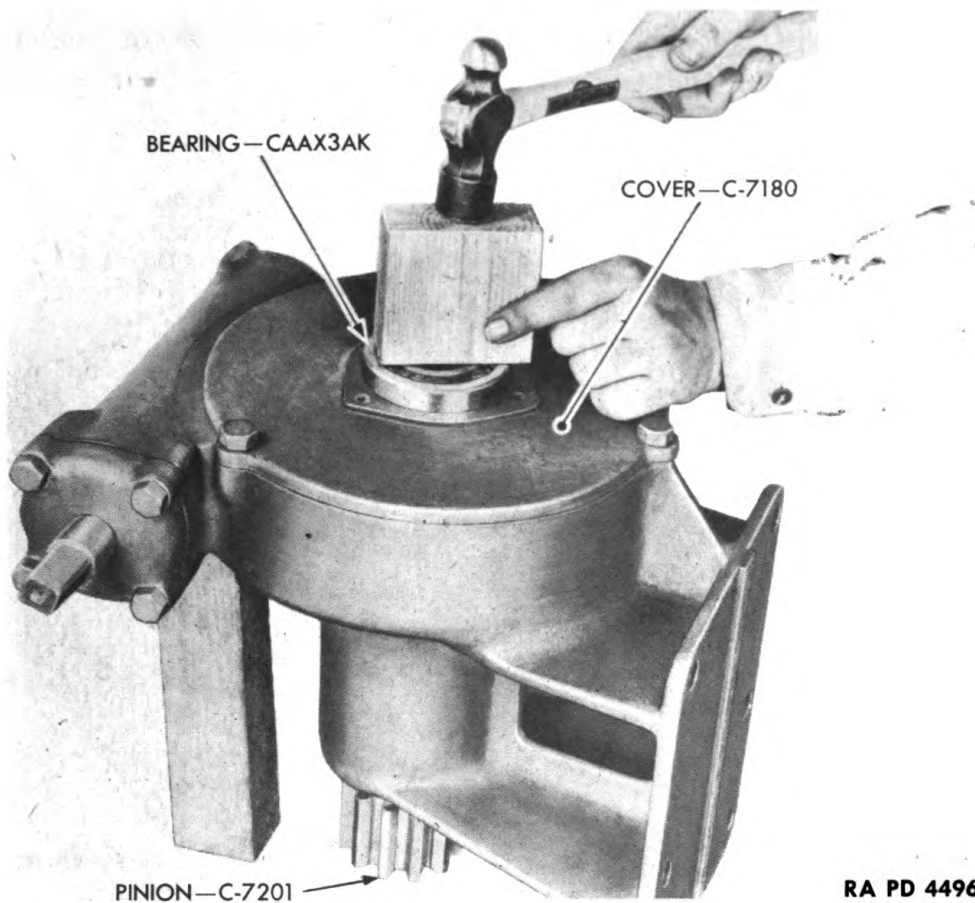
Connect the air drill to the traversing worm shaft by using the flexible joint A19909 and a steel bar. The steel bar should be $\frac{7}{8}$ -inch diameter x 8 inches long, squared to $\frac{13}{16}$ -inch on one end to fit the joint, and tapered on the other end to fit an air drill. Operate the air drill and check the action of the traversing gear mechanism (fig. 161). If "hard spots" are indicated, drain oil from gear housing; remove the large gear housing cover; coat worm and worm wheel where hard spots occur with fine valve grinding compound. Reinstall cover on gear housing and "lap in" the worm and worm wheel by reversing the air drill until the "hard spots" are removed. Remove cover again; clean worm and worm wheel with SOLVENT, dry-cleaning; fill housing to proper level with oil; reinstall cover on housing.

(14) Remove air drill, steel bar, and flexible joint. Secure the screws of all covers with safety wire.

b. Assemble Traversing Handwheel, Bracket, and Shaft (fig. 149).

(1) Pack the traversing handwheel shaft self-aligning ball bearing with GREASE, general purpose (seasonal grade). Work grease well into balls and races. Coat the bearing seat on traversing handwheel

TRAVERSING MECHANISM



RA PD 44969

Figure 160—Installing Bearing in Traversing Gear Housing Cover

shaft with grease. Place shaft in a vise fitted with copper jaws and tap the bearing in place on the shaft.

(2) Insert the traversing handwheel shaft and bearing in position in traversing handwheel shaft bracket. Pack the bearing recess of bracket with **GREASE**, general purpose (seasonal grade), after tapping bearing into place.

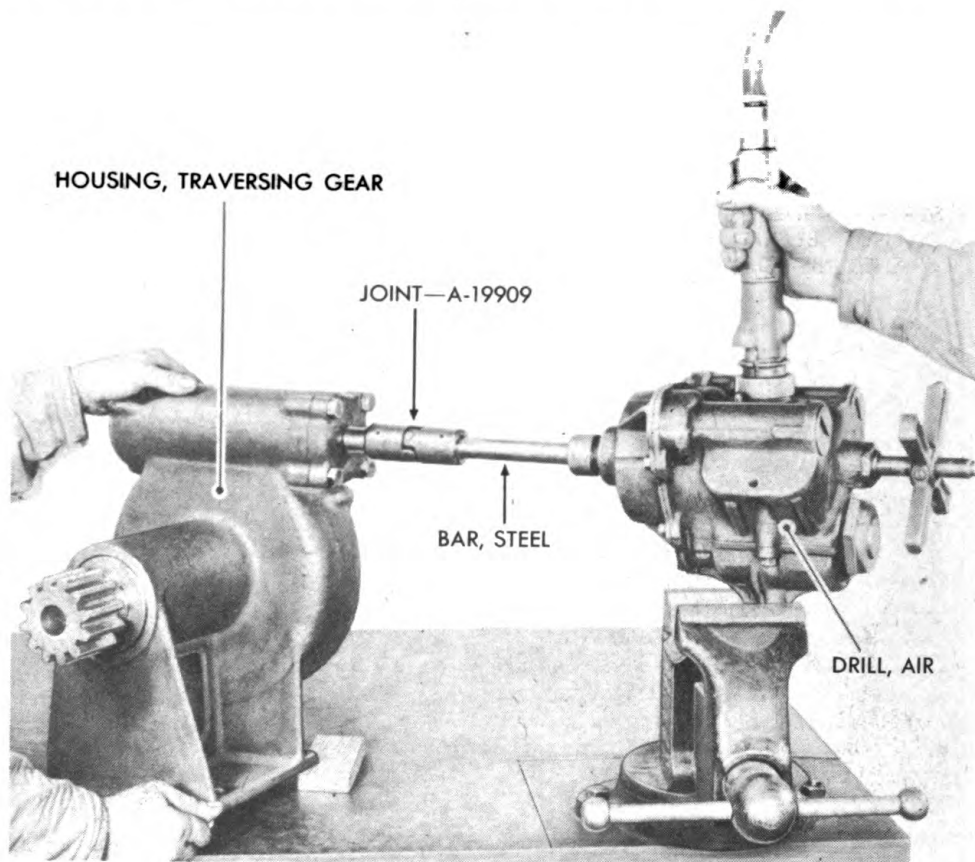
(3) Install the traversing handwheel shaft bracket cover on the bracket and secure with three screws and washers after coating threads of screws with **COMPOUND**, rust-preventive, light.

(4) Place the traversing handwheel key in position in the traversing handwheel shaft and tap traversing handwheel in position on shaft. Secure with traversing handwheel shaft washer and nut after coating shaft threads with **COMPOUND**, rust-preventive, light.

67. MOUNT TRAVERSING MECHANISM ON CARRIAGE.

NOTE: The correct procedure for mounting the traversing mechanism on the top and bottom carriages is given below. In complete

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44983

Figure 161—Lapping Traversing Worm Wheel and Worm

disassembly of the top and bottom carriages, the traversing mechanism is not mounted until after the elevating mechanism has been removed from the top carriage and complete maintenance operations have been performed as outlined in section XVI.

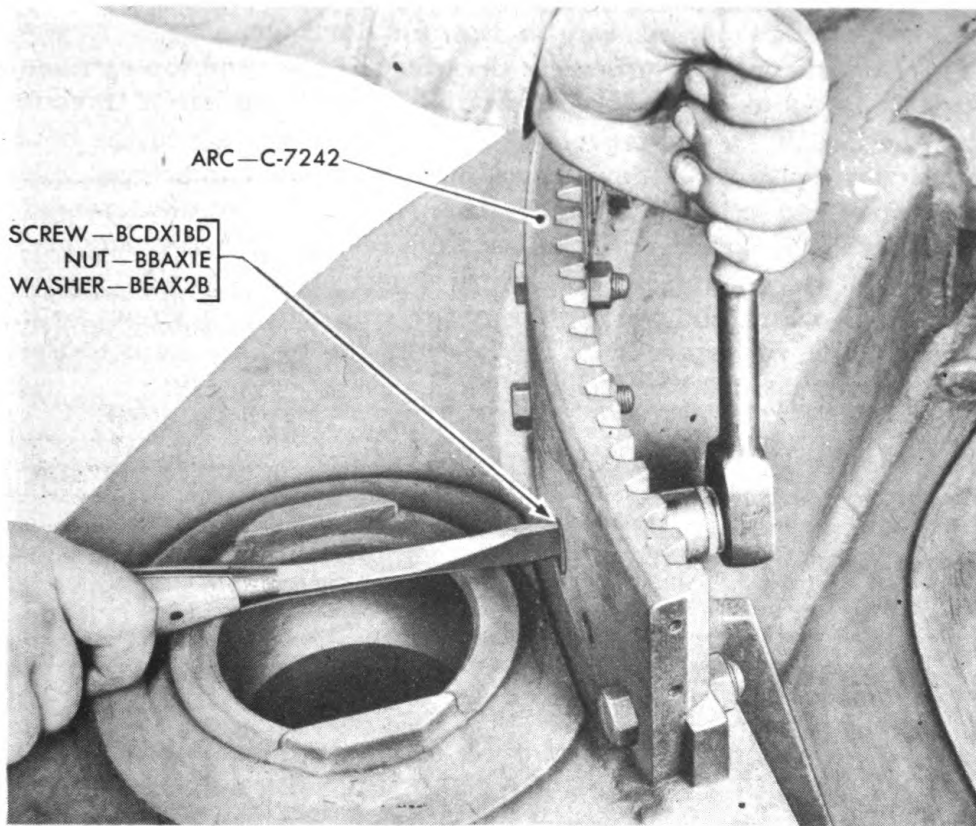
a. Mount Traversing Gear Housing Assembly.

(1) Coat the mating surfaces of traversing gear housing and top carriage with **LEAD**, white. Also coat threads of the six traversing gear housing retaining screws with **COMPOUND**, rust-preventive, light. With two men holding traversing gear assembly in place, insert the six screws from inside the top carriage through the mounting flange of the gear housing. Put washers and nuts on screws and tighten nuts (figs. 147 and 148).

NOTE: The three long screws go in the holes nearest the front of the top carriage.

(2) Coat the squared end of traversing worm and mating surface of flexible joint with **COMPOUND**, rust-preventive, light. Line up

TRAVERSING MECHANISM



RA PD 44530

Figure 162—Replacing Traversing Arc Screw

cotter pin holes in worm and joint, and tap joint into place on worm. Insert cotter pin.

b. Mount Traversing Handwheel, Bracket, and Shaft Group.

(1) Coat the mating surfaces of traversing handwheel shaft bracket D7000 and top carriage with **LEAD**, white. Also coat the two shaft bracket dowels and the threads of the five shaft bracket retaining screws with **COMPOUND**, rust-preventive, light.

(2) Coat the mating surfaces of traversing handwheel shaft and flexible joint with **COMPOUND**, rust-preventive, light. Push the traversing handwheel shaft into position in flexible joint. Line up holes in the traversing handwheel shaft bracket and top carriage and secure bracket to top carriage with two dowel pins and five screws, washers, and nuts. Put the screws in from inside the top carriage.

(3) Insert cotter pin in flexible joint and traversing handwheel shaft.

(4) Turn traversing handwheel and check the action of the traversing mechanism. It must be free and smooth, without binding or backlash.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

c. Mount Traversing Arc on Bottom Carriage.

(1) Coat the mating surfaces of the traversing arc and top carriage with **LEAD**, white. Coat the three dowel pins and nine screw threads with **COMPOUND**, rust-preventive, light. Secure the arc to the bottom carriage with three dowel pins, eight standard cap screws, and one fillister-head screw, nuts, and washers (fig. 162). This fillister-head screw goes in the hole next to the last from rear end of traversing arc.

(2) Coat the mating surfaces of traversing arc and two arc stops with **LEAD**, white, and the threads of arc stop retaining screws with **COMPOUND**, rust-preventive, light. Secure the two arc stops to the arc with screws and washers (fig. 144).

Section XVI

ELEVATING MECHANISM

	Paragraph
General	68
Malfunctions	69
Remove elevating mechanism from top carriage	70
Disassemble elevating mechanism	71
Maintenance and repair of elevating mechanism	72
Assemble elevating mechanism	73
Mount elevating mechanism on top carriage	74

68. GENERAL.

a. Description, functioning, and operation of the elevating mechanism are covered in paragraphs 13 and 26, TM 9-335 and paragraphs 13 and 25 a, TM 9-350.

b. Complete disassembly of the elevating mechanism for overhaul, after the top carriage has been removed from the carriage, is outlined in this section.

NOTE: The elevating mechanism, with the exception of the elevating arc which is attached to under side of the cradle, can be removed from the top carriage while the top carriage is in place on the carriage. The procedure for removal and disassembly of the elevating mechanism is the same regardless of whether the top carriage is on or off the carriage and/or the traversing mechanism is attached or removed from the top carriage (figs. 163 and 164).

69. MALFUNCTIONS.

a. Backlash in Excess of One-sixth Turn of Handwheel.

Cause	Correction
Worn parts in elevating mechanism.	Remove elevating mechanism from top carriage; disassemble and repair (pars. 70, 71, and 72).

b. Difficult to Elevate Gun or Howitzer.

Equilibrator out of adjustment with temperature scale or loss of equilibrator pressure.	Adjust equilibrator for correct temperature (par. 14, TM 9-335 or par. 13, TM 9-350), or replace equilibrator (pars. 27 and 118).
Binding in elevating mechanism.	Remove, disassemble, and repair elevating mechanism (pars. 70, 71, and 72).

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

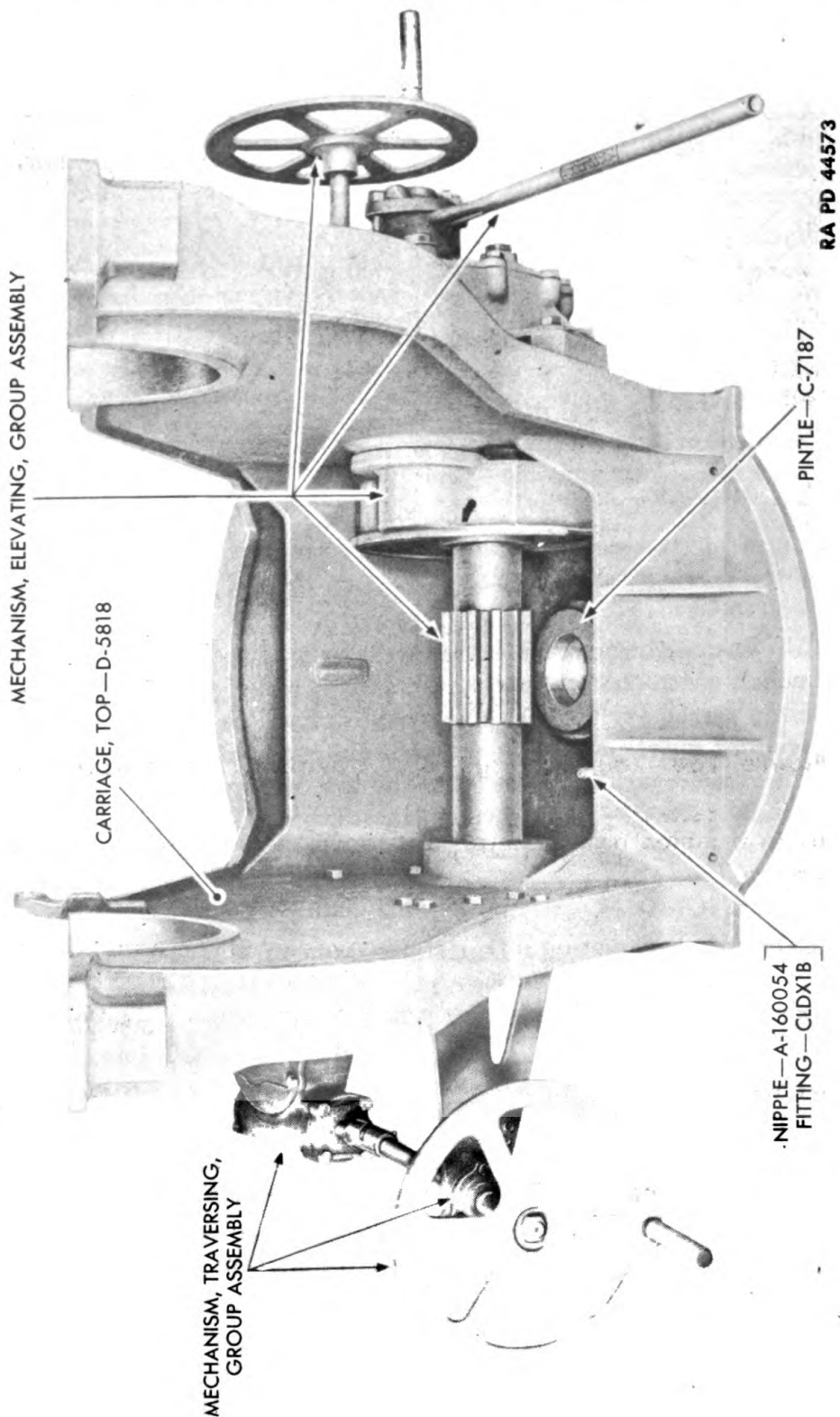
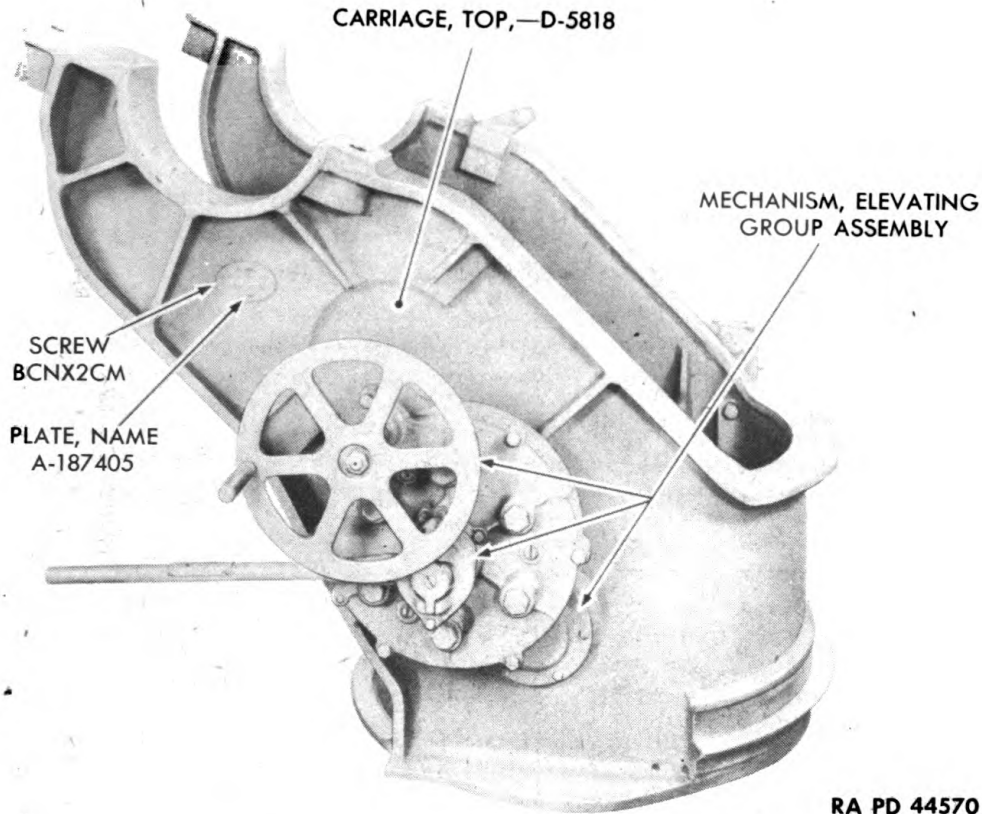


Figure 163—Top Carriage—Elevating and Traversing Mechanism

ELEVATING MECHANISM



RA PD 44570

Figure 164—Top Carriage and Elevating Mechanism

Cause	Correction
Binding in trunnion bearing cap assembly.	Remove, disassemble, and repair trunnion bearing cap (pars. 47, 48, and 49).
Broken teeth in elevating arc and/or elevating shaft.	Remove elevating arc and/or elevating shaft and repair or replace (pars. 51 a, 70 b, 72, and 60 d).

70. REMOVE ELEVATING MECHANISM FROM TOP CARRIAGE.

a. Remove Elevating Handwheel Gear Mechanism Assembly.

(1) Remove two screws BCBX2BB and washers BEAX2D that hold housing D5817 in place on top carriage (fig. 165).

(2) Pry the elevating handwheel gear mechanism assembly loose from the top carriage, while another man holds the assembly. Lift the assembly away (fig. 166).

b. Remove Elevating Shaft, Gear, and Cover.

(1) Remove nipple A160054 and fitting CLDX1B as unit (fig. 163).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

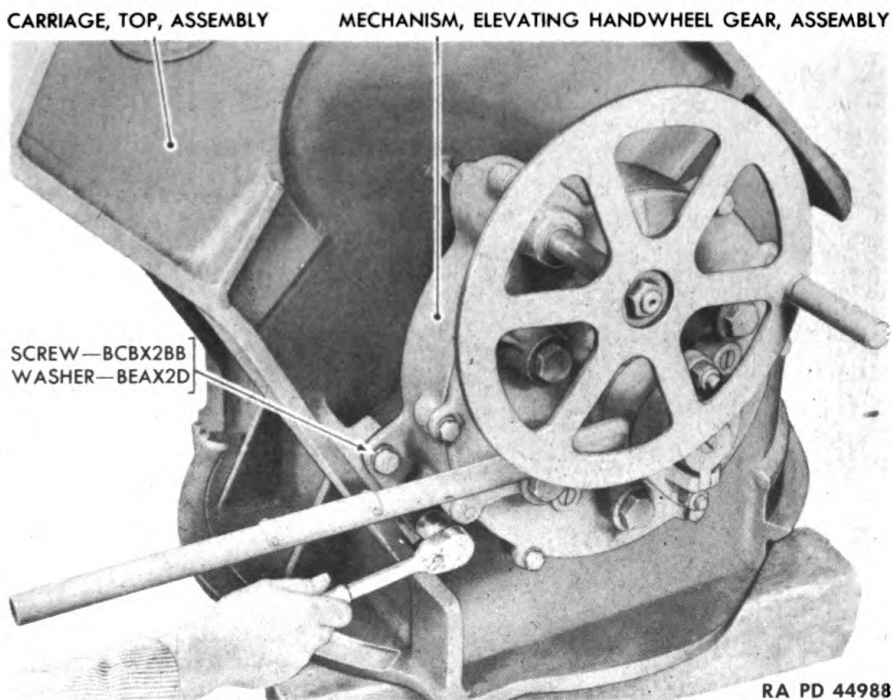


Figure 165—Removing Screws from Elevating Handwheel Gear Housing

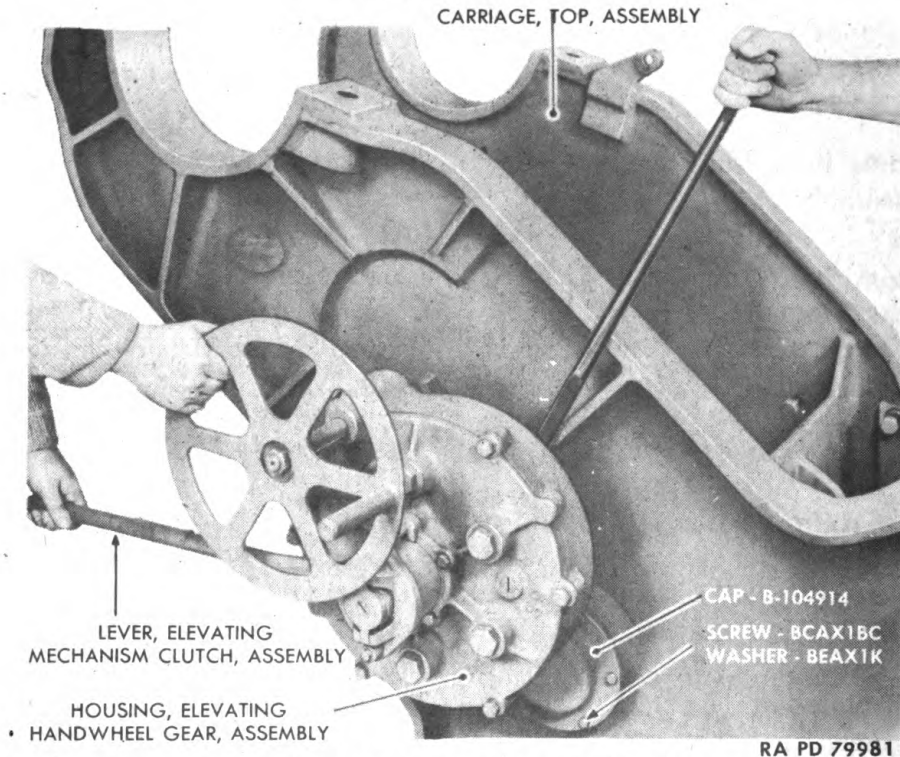
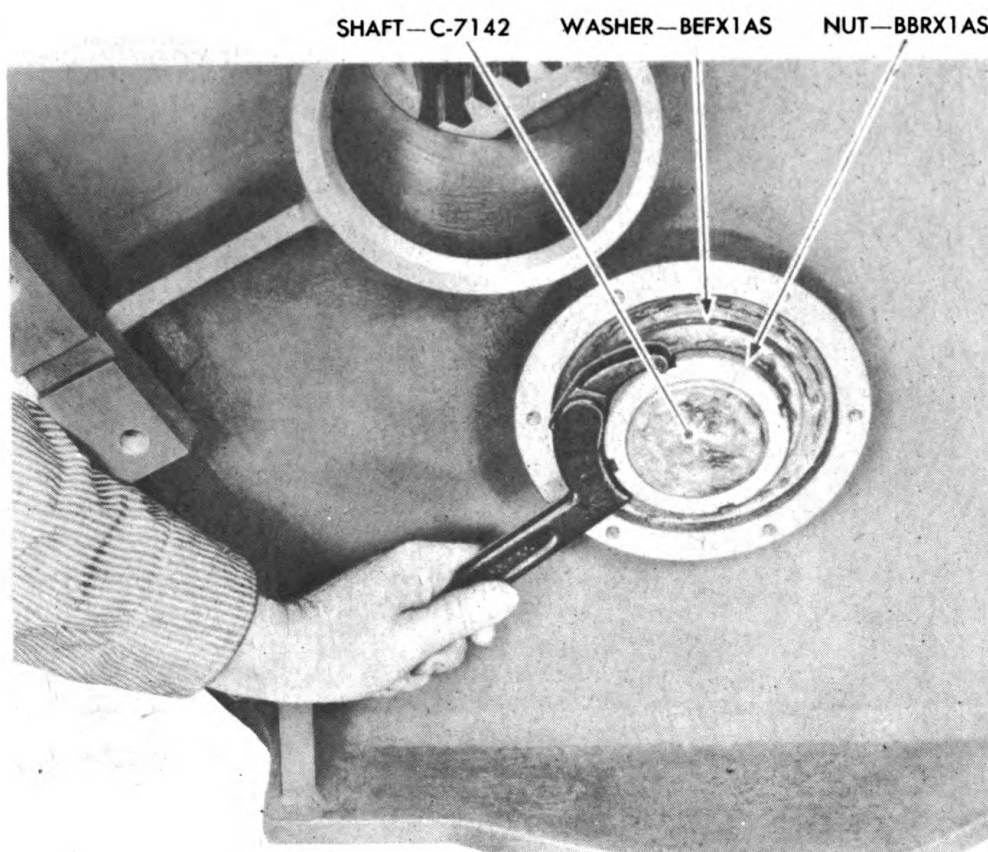


Figure 166—Removing Elevating Handwheel Gear Mechanism Assembly from Top Carriage

ELEVATING MECHANISM



RA PD 44984

Figure 167—Removing Lock Nut and Washer from Elevating Shaft

(2) Remove screws BCAX1BC and washers BEAX1K. Remove caps B104914 and shims B108046 from both sides of top carriage (figs. 166 and 183). **NOTE:** Shims are used only as required to obtain proper clearance between cap flanges and roller bearing cup on elevating gear shaft (par. 74).

(3) Straighten the lug on washer BEFX1AS and unscrew and remove nut BBRX1AS from shaft C7142 (fig. 167). Repeat the above operations and remove lock washer and lock nut from other end of shaft. Do not remove bearings yet.

(4) Remove eight screws BCGX1.1BF and washers BEAX1F from ring B160154 (fig. 168). Slide ring back over pinion on shaft. Remove seal B160094 and slide it back over pinion.

(5) Drive shaft C7142 back through top carriage from the right side (fig. 169). Shaft will come out left side of top carriage. Bearings B104910, seals A171326, and rings B158241 will remain on shaft. Slide shaft over to left and balance it in the left end cover opening so that the elevating gear cover C73312 can be removed (fig. 170).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

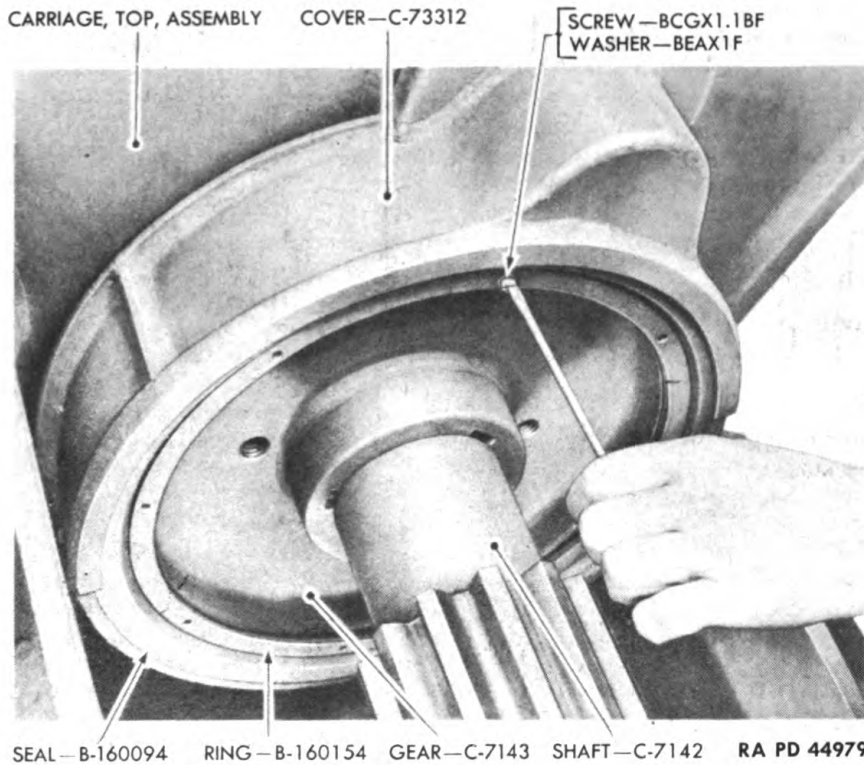


Figure 168—Removing Ring from Elevating Gear Cover

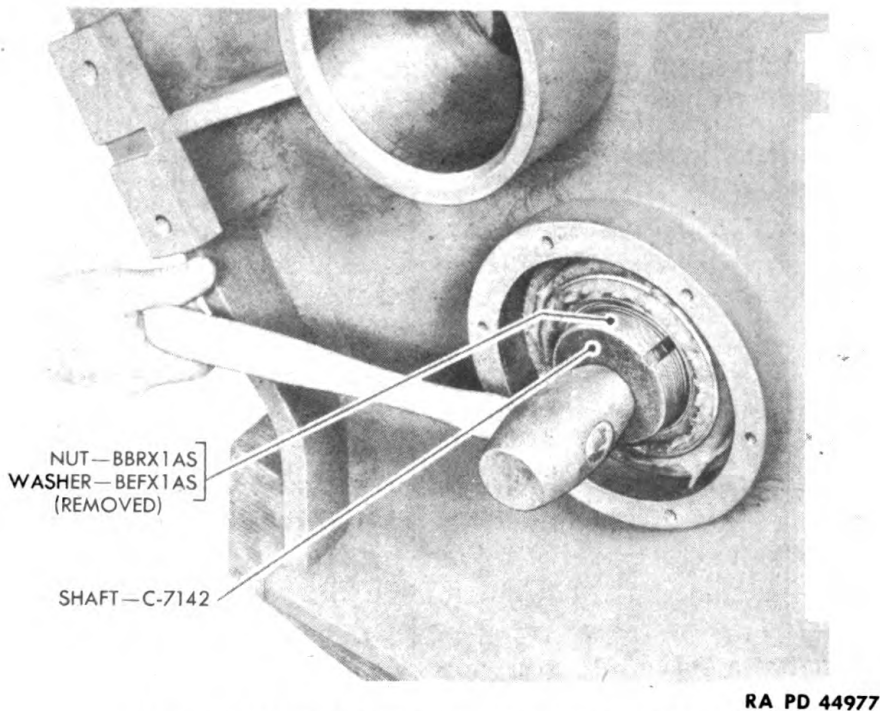


Figure 169—Removing Elevating Shaft

ELEVATING MECHANISM

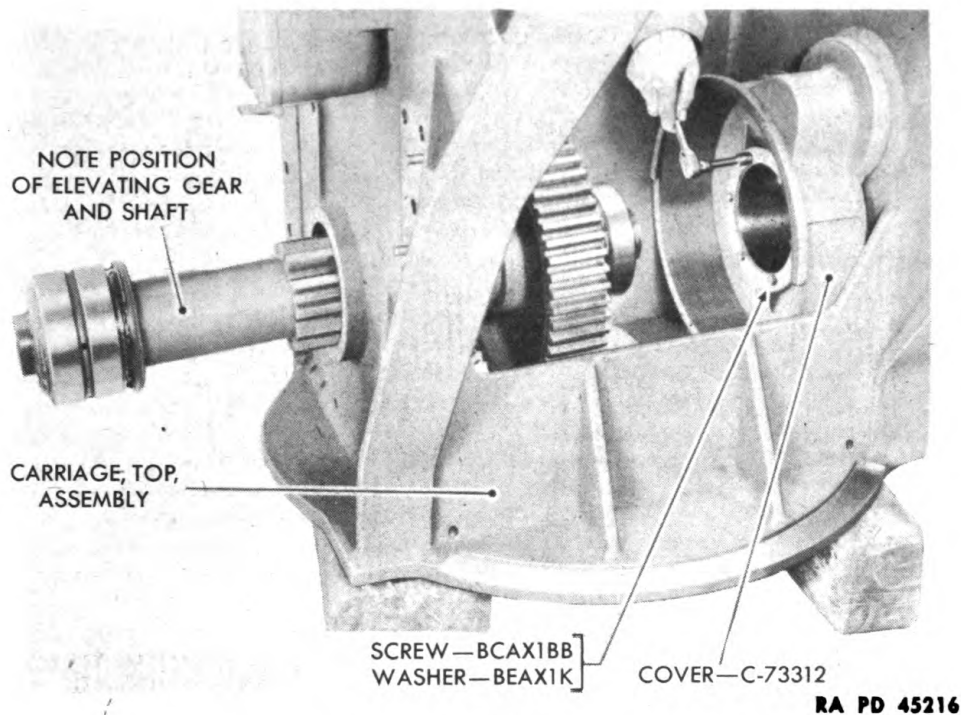


Figure 170—Removing Elevating Gear Cover Screws

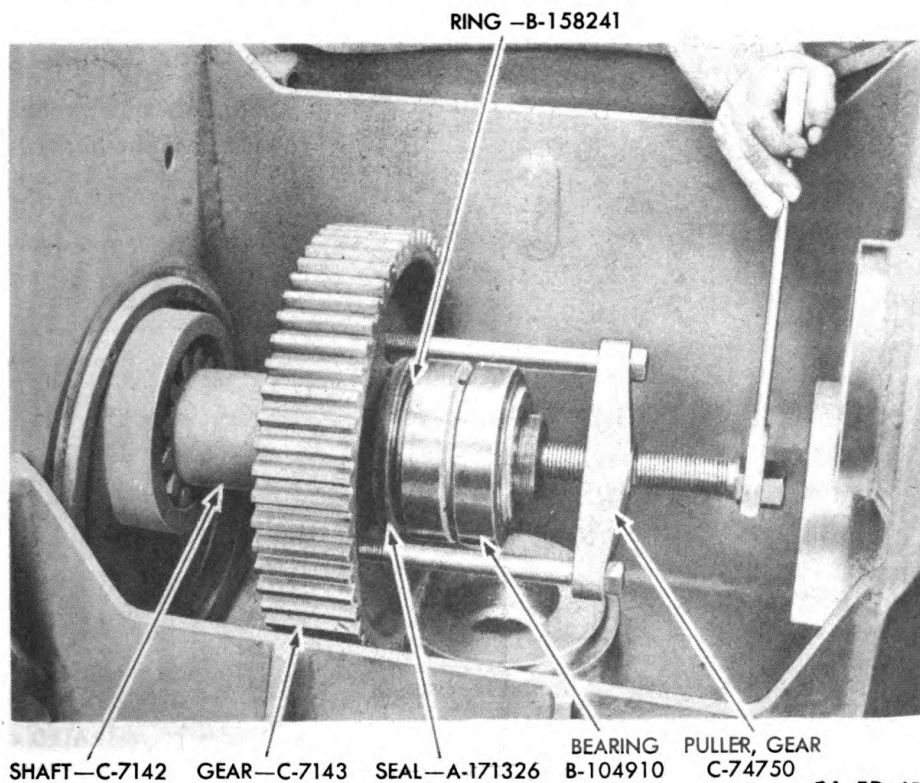


Figure 171—Removing Elevating Shaft Gear

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

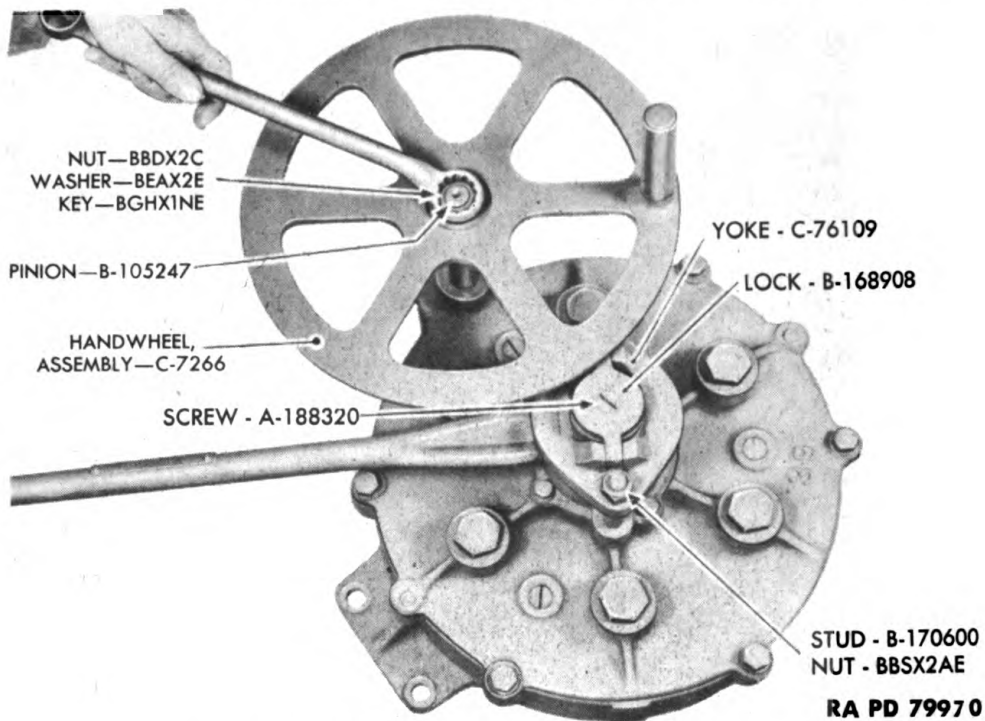


Figure 172—Removing Elevating Handwheel

(6) Remove six screws BCAX1BB and washers BEAX1K. Remove cover C73312 (figs. 170 and 183).

(7) Install gear puller C74750 in gear C7143 and tighten center screw of puller up against end of shaft C7142. Force right-hand bear-

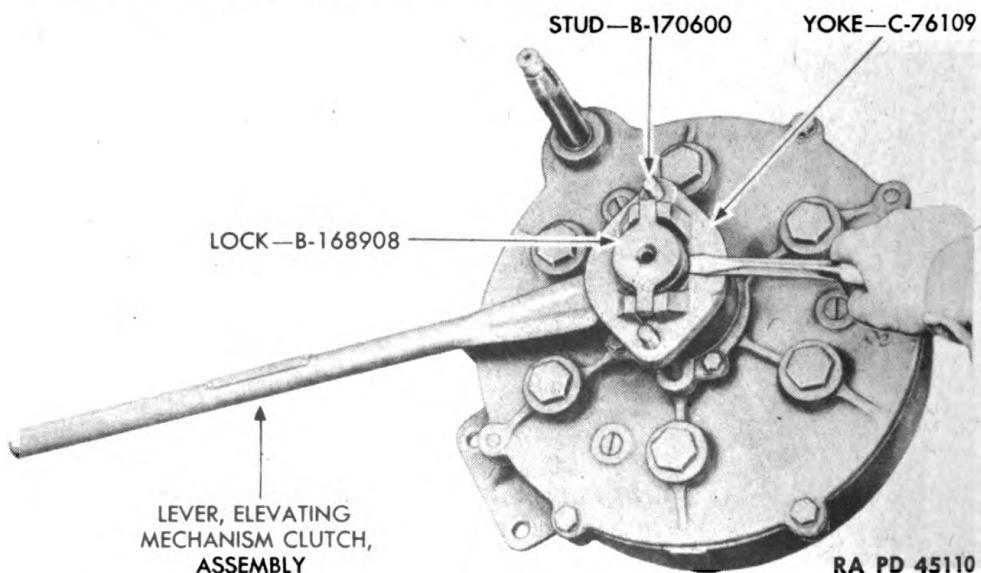


Figure 173—Removing Elevating Mechanism Clutch Lever Assembly

ELEVATING MECHANISM

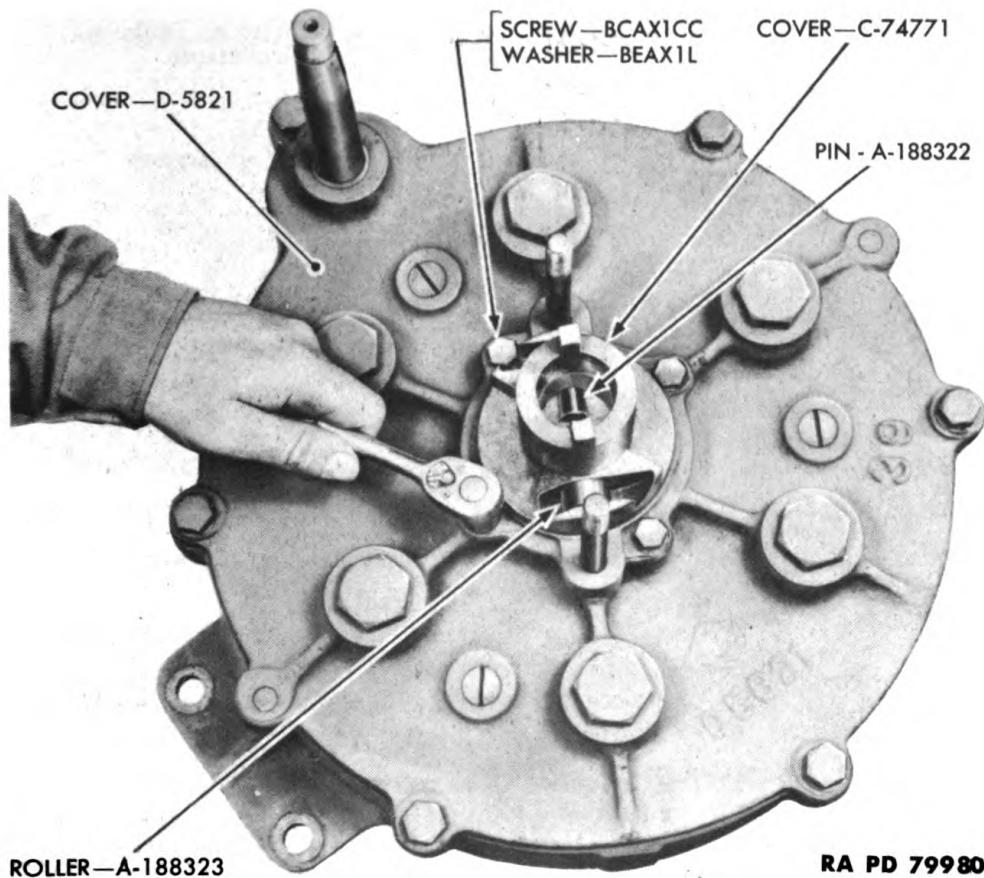


Figure 174—Removing Elevating Brake Drum Shaft End Cover

ing B104910, seal A171326, ring B158241, and gear C7143 from shaft (fig. 171). Remove three keys A19621 from shaft (fig. 183). Remove shaft C7142 with left-hand bearing B104910, seal A171326, and ring B158241 from top carriage.

71. DISASSEMBLE ELEVATING MECHANISM.

a. **Remove Bearings and Seals from Elevating Shaft.** If bearing B104910, seal A171326, ring B158241 on left end of shaft C7142, or shaft C7142 is damaged and must be replaced, place shaft in an arbor press and press the shaft out of bearing, seal, and ring.

b. **Disassemble Elevating Handwheel Gear Mechanism Assembly.**

(1) Remove nut BBDX2C and washer BEAX2E from pinion B105247 (fig. 172). Tap handwheel assembly C7266 off pinion and remove key BGHX1NE.

(2) Remove screw A188320 from lock B168908.

(3) Remove two nuts BBSX2AE from studs B170600. Pry lock

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

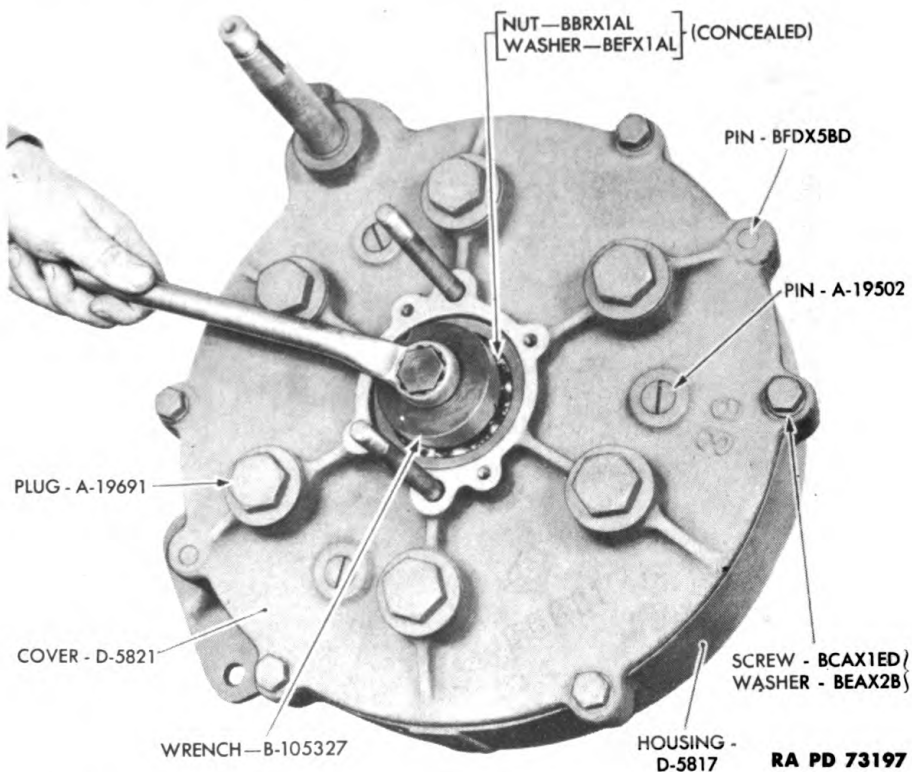


Figure 175—Removing Nut and Washer from Elevating Brake Drum Shaft

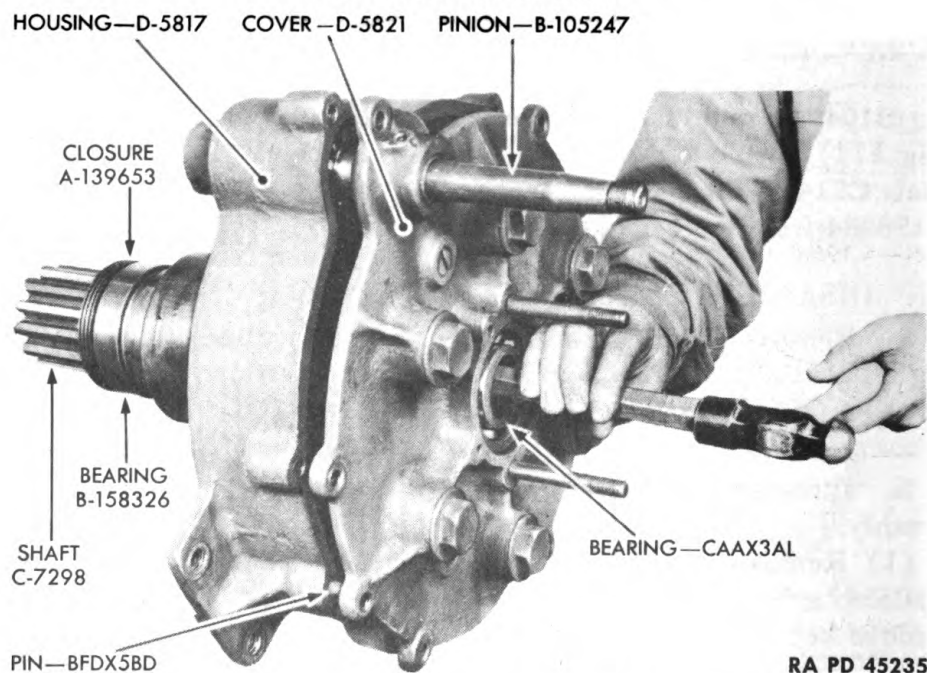


Figure 176—Removing Elevating Brake Drum Shaft
194

ELEVATING MECHANISM

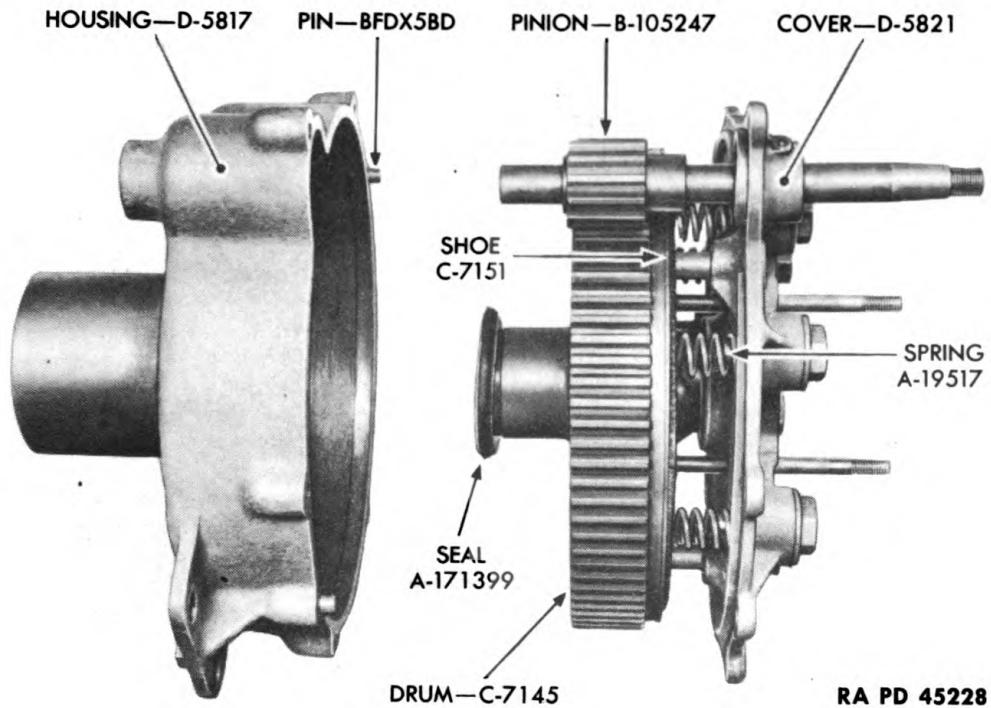


Figure 177—Elevating Brake Drum and Handwheel Gear Housing Group

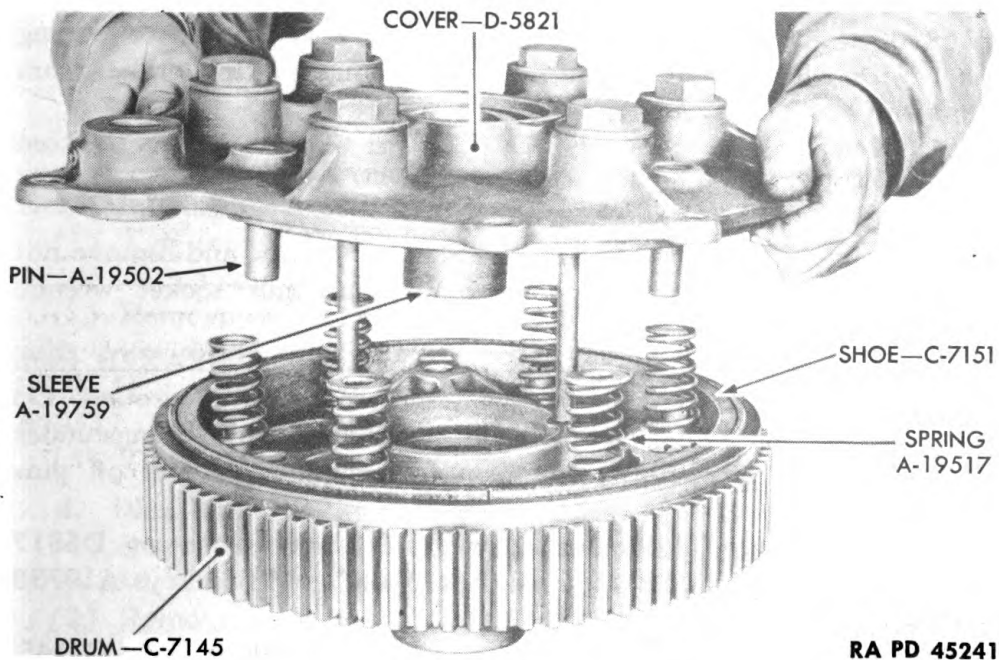


Figure 178—Removing Housing Cover from Elevating Brake Drum
195

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

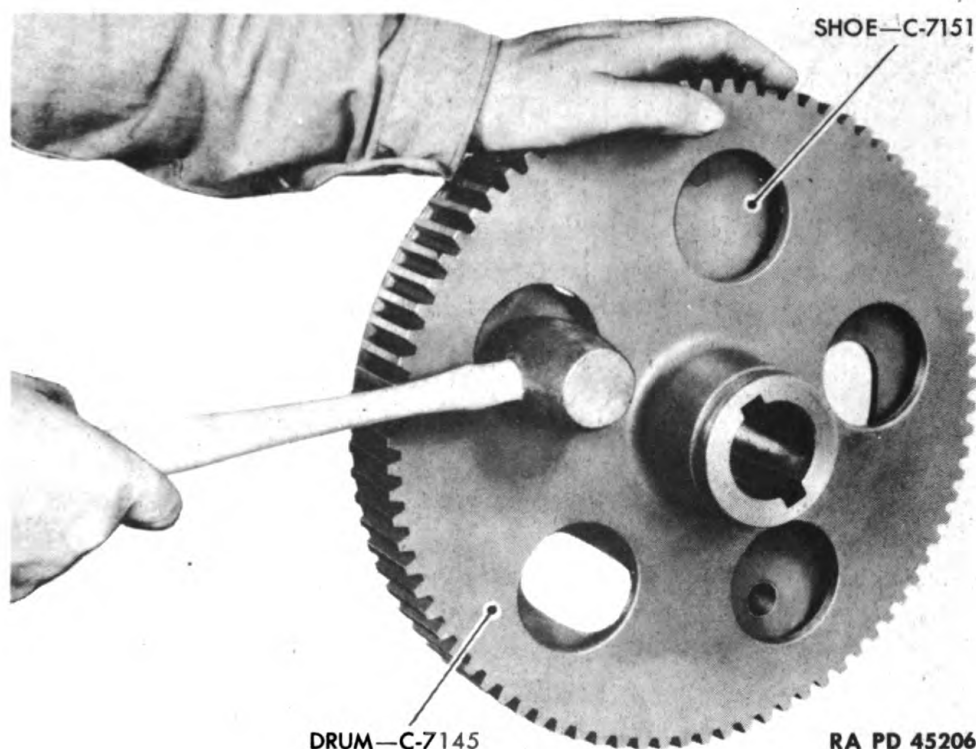


Figure 179—Removing Shoe from Elevating Brake Drum

B168908 from yoke C76109 (fig. 173). Pry yoke off. Lift elevating mechanism clutch lever assembly away from elevating brake drum shaft end cover C74771.

(4) Remove four screws BCAX1CC and washers BEAX1L from cover C74771. Remove cover. Pins A188322 and rollers A188323 come away as part of cover (fig. 174).

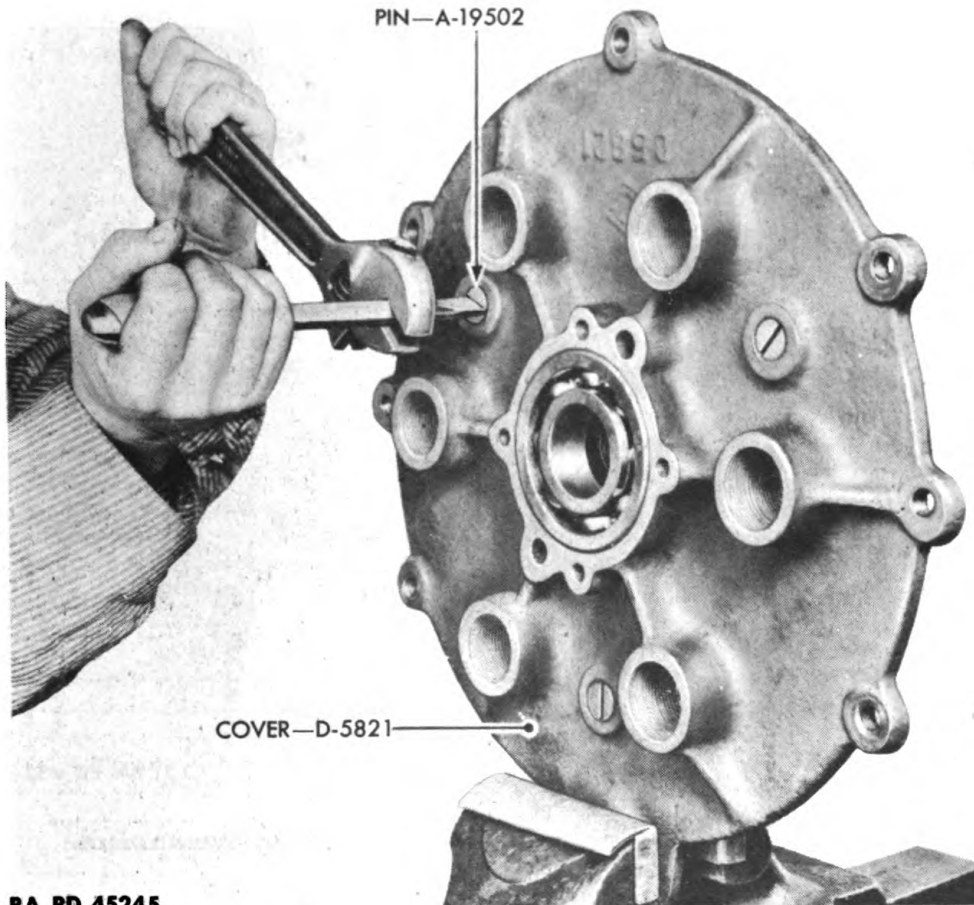
(5) Straighten lug on washer BEFX1AL, unscrew and remove nut BBRX1AL with elevation intermediate shaft nut socket wrench B105327 (fig. 175). Remove washer.

(6) Remove six screws BCAX1ED and washers BEAX2B from cover D5821 (fig. 175). Loosen these screws evenly all around. Do not remove one at a time, as this releases compression on springs under plugs A19691. Pry cover away from housing D5817 and off pins BFDX5BD.

(7) Drive shaft C7298 back through and out of housing D5817 (fig. 176). Bearing B158326, closure A139653, and two keys A19758 will come away with shaft.

(8) After shaft has been driven out, pull cover D5821, drum C7145, pinion B105247, shoe C7151, seal A171399, and springs A19517 (as a unit) from housing D5817 (fig. 177).

ELEVATING MECHANISM



RA PD 45245

Figure 180—Removing Elevating Clutch Shoe Guide Pin

c. Remove Elevating Brake Drum from Elevating Handwheel Gear Housing Cover.

(1) Tap pinion B105247 back out of cover D5821 and drum C7145, with a copper hammer.

(2) Remove seal A171399 from drum. Turn cover and drum over with drum down and lift cover from drum (fig. 178). Six washers BEBX1P will drop out of cover when cover is lifted away from springs A19517. Remove springs and sleeve A19759.

(3) Tap shoe C7151 from drum C7145 (fig. 179).

d. Disassemble Elevating Handwheel Gear Housing Cover.

(1) Place the cover D5821 in a vise fitted with copper jaws. Unscrew and remove six plugs A19691.

(2) Remove three pins A19502 from cover D5821 (fig. 180).

(3) Place the cover, with outside face down, on two wood blocks. Place sleeve A19759 on bearing CAAX3AL and drive out bearing (fig. 181).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

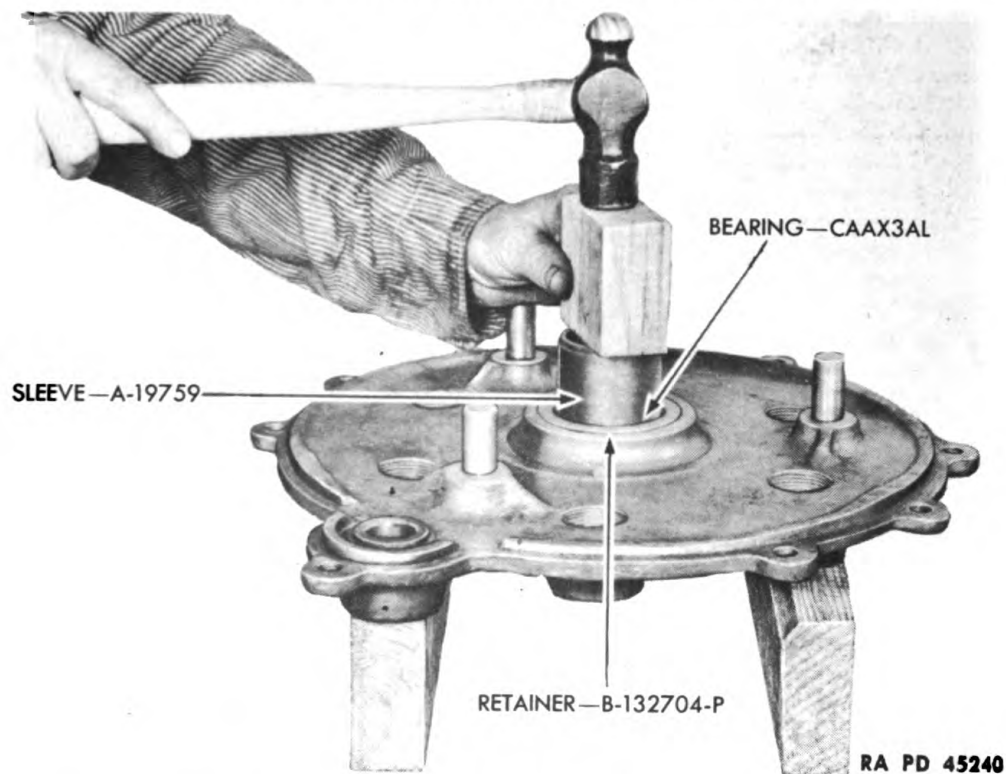


Figure 181—Removing Bearing from Elevating Mechanism Housing Cover

c. **Disassemble Elevating Brake Drum Shaft Closure and Bearing.** Place shaft C7298 in a round steel block with a $3\frac{5}{8}$ -inch diameter hole in it. Drive shaft C7298 out of bearing B158326 and closure A139653 (fig. 182). This can also be done on an arbor press.

72. MAINTENANCE AND REPAIR OF ELEVATING MECHANISM.

a. General.

- (1) Clean all parts thoroughly in SOLVENT; dry-cleaning.
- (2) Check gears, shafts, bushings, bearings, oil seals, oil retainers, springs, brake drum and lining, clutch lever, housing, and cover, for wear or damage.
- (3) Replace all worn or damaged parts.

b. **Repair Burred Gear Teeth** (figs. 183, 184, and 185). Carefully check all teeth of the elevating arc, elevating shaft, elevating shaft gear, elevating brake drum, elevating brake drum shaft, and elevating handwheel pinion. Smooth a burred or nicked tooth with a smooth file and polish with CLOTH, crocus. Then clean with SOLVENT, dry-cleaning. Worn or broken teeth cannot be repaired. Replace the part with a new one.

ELEVATING MECHANISM

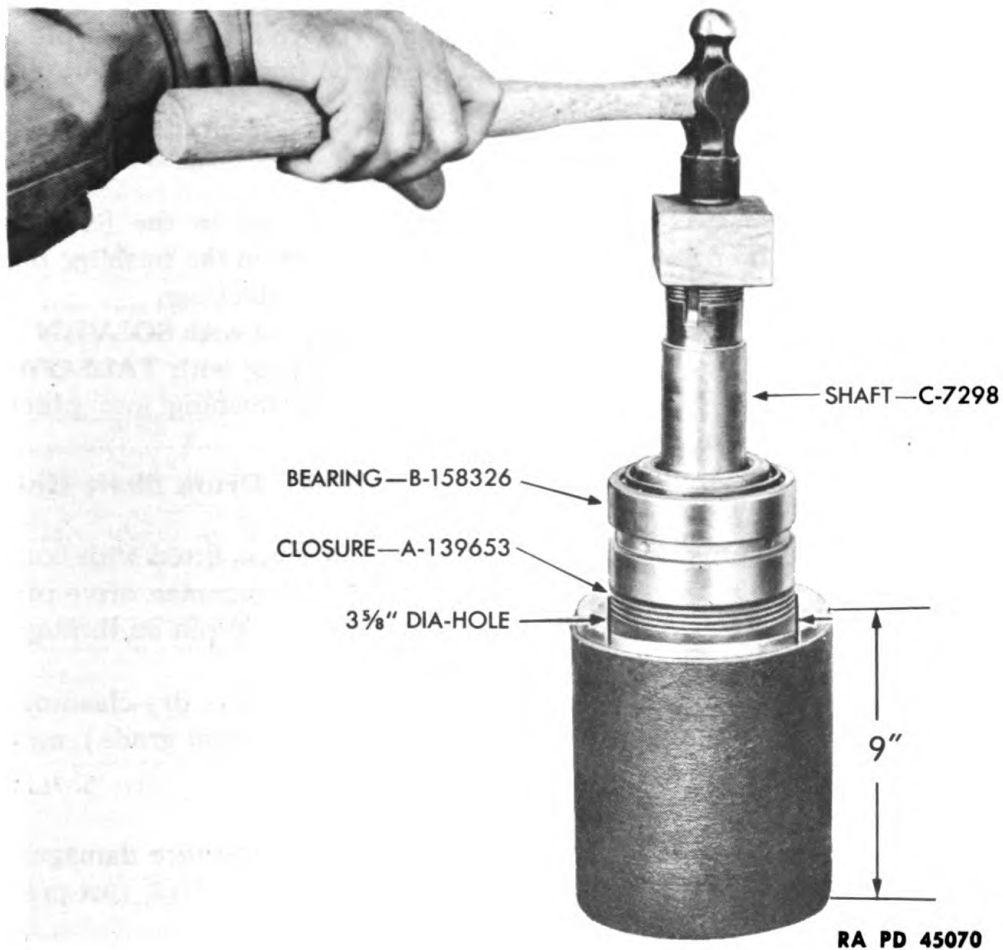


Figure 182—Removing Bearing and Closure from Elevating Brake Drum Shaft

c. Replace Damaged Oil Retainers. There are two oil retainers, one in brake drum C7145, and one in the elevating handwheel gear housing cover D5821. If damaged, drive the retainer out with a brass drift and hammer. Clean retainer seat in cover and drum, then drive the new retainer in place, using a wood block and hammer (fig. 186). The retainer must be installed in the drum and cover with the leather edge toward the bearing in the front of the cover.

d. Replace Worn Brake Drum Bushings (fig. 187).

(1) There are three self-lubricating bushings in the elevating clutch shoe. If worn, replace.

(2) Drive the bushing out with a $1\frac{3}{16}$ -inch diameter by 6-inch steel bar and a hammer.

(3) Clean the bushing opening in elevating clutch shoe with SOLVENT, dry-cleaning. Coat the outside surface of the new bushing with

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

TALLOW, mutton, refined, or LEAD, white. Drive bushing into place with the bushing face flush with the face of the boss on the elevating clutch shoe (fig. 187).

e. Replace Worn Bushing in Elevating Mechanism Housing or Cover (fig. 188).

(1) There are two self-lubricating bushings; one in the housing cover, and the other in the housing. When worn, drive the bushing out using a hammer and a 1 1/8-inch diameter x 6-inch steel bar.

(2) Clean the bearing opening in cover or housing with SOLVENT, dry-cleaning. Coat the outside surface of new bushing with TALLOW, mutton, refined, or LEAD, white, and drive the bushing into place with wood block and hammer (fig. 188).

f. Replace Worn Roller in Elevating Brake Drum Shaft End Cover.

(1) Place the brake drum shaft end cover in a vise fitted with copper jaws (fig. 189). Using a 1/4-inch brass drift and hammer, drive pin A188322 out of roller A188323. Remove roller. Drive pin on through and remove the other roller and pin.

(2) Clean the end cover thoroughly in SOLVENT, dry-cleaning. Coat the new pins and rollers with OIL, engine (seasonal grade), and install in the end cover.

g. Repair Elevating Clutch Shoe.

(1) Tighten all loose spring guide pins A19484. Replace damaged pins (fig. 190). Coat new pin threads with COMPOUND, rust-preventive, light.

(2) Remove bent or damaged elevating clutch shoe stud B170600 by removing safety set screw BCTX1BD (fig. 191). Using 7/16-inch stud remover and universal "ell" handle, unscrew the stud (fig. 192). Coat threads of new stud with COMPOUND, rust-preventive, light, and install in elevating clutch shoe. Secure with safety set screw and stake the stud in four places.

(3) Roughen a glazed clutch shoe lining with a coarse file.

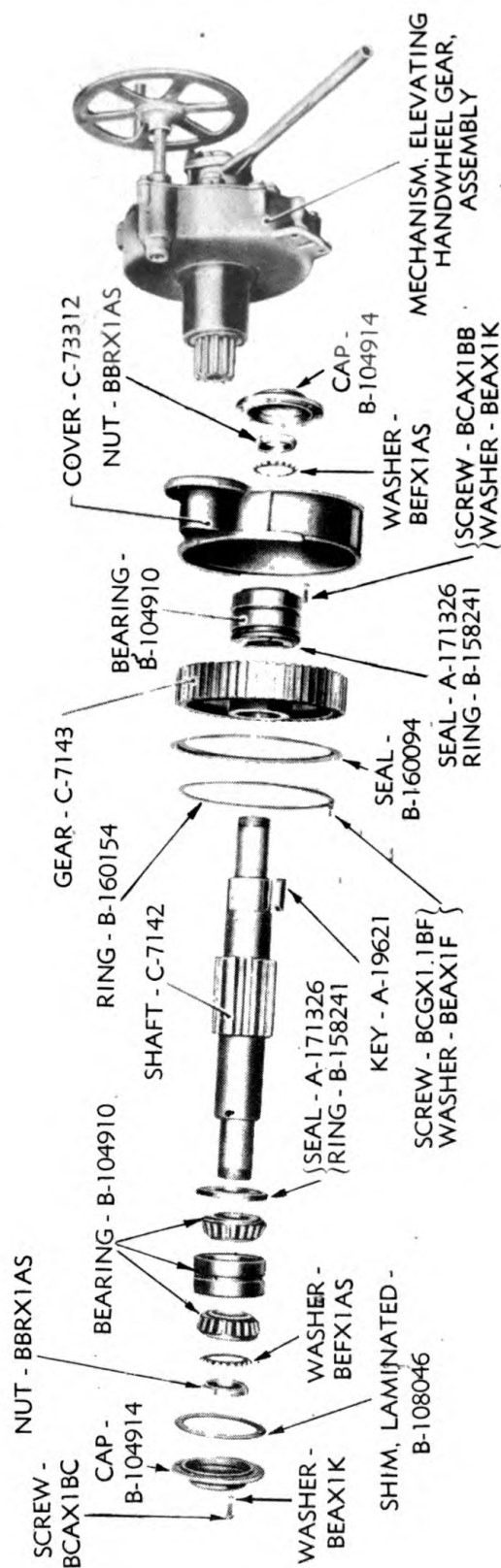
(4) Replace badly worn lining. Drive rivets out with punch and hammer. Remove old lining. Place new lining on clutch shoe and rivet in place.

73. ASSEMBLE ELEVATING MECHANISM.

a. Assemble Elevating Brake Drum Shaft, Closure, and Bearing.

(1) To facilitate the assembly of the elevating brake drum shaft bearing, rotate the bearing, while clamping to insure that rollers are properly seated against cone rib. Heat entire bearing in OIL, engine, SAE 30, at about 305 F for 1 1/4 hours. Then press the bearing with bearing closure in place on shaft. Be sure that cupped side of closure

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RA-PD 73188

Figure 183—Elevating Mechanism

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

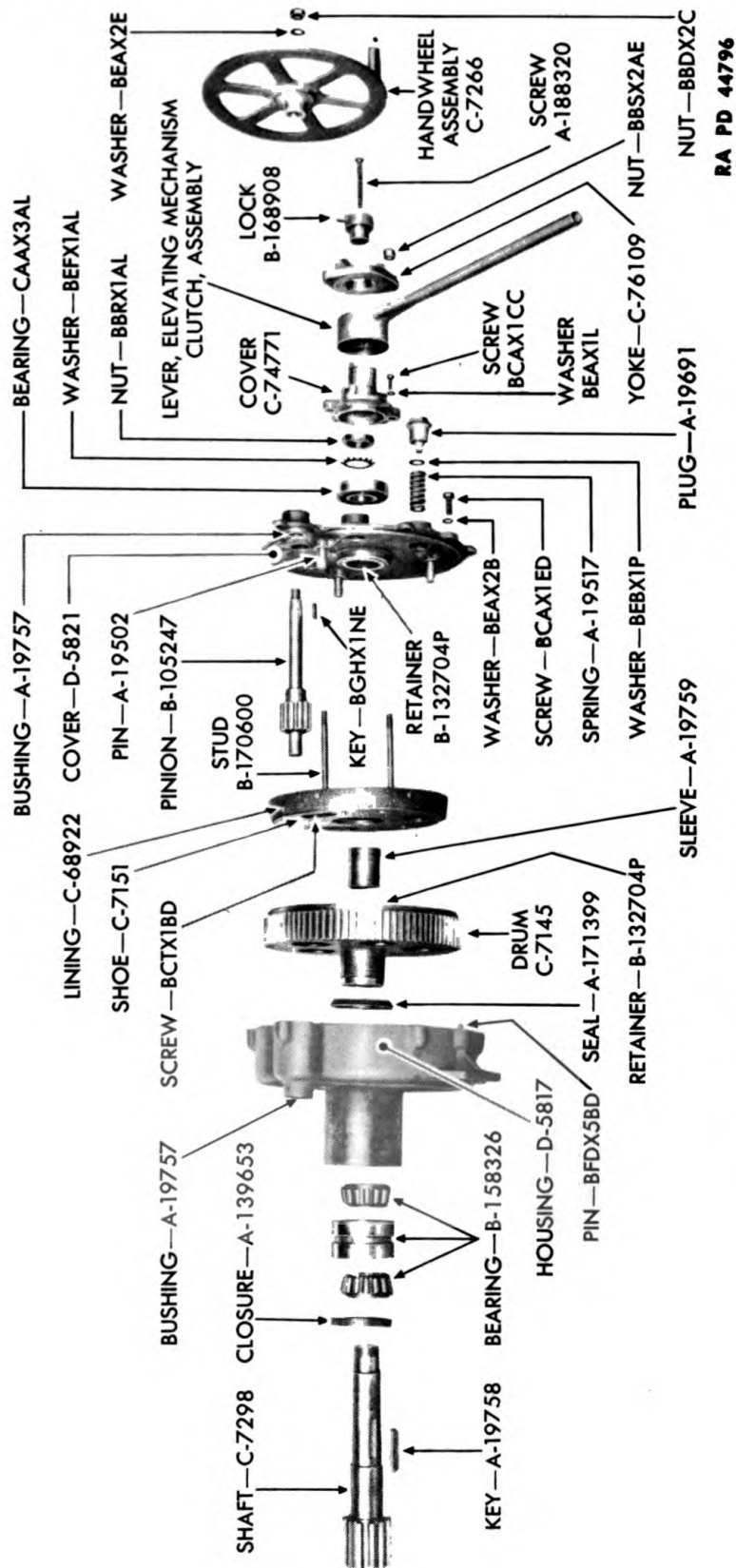
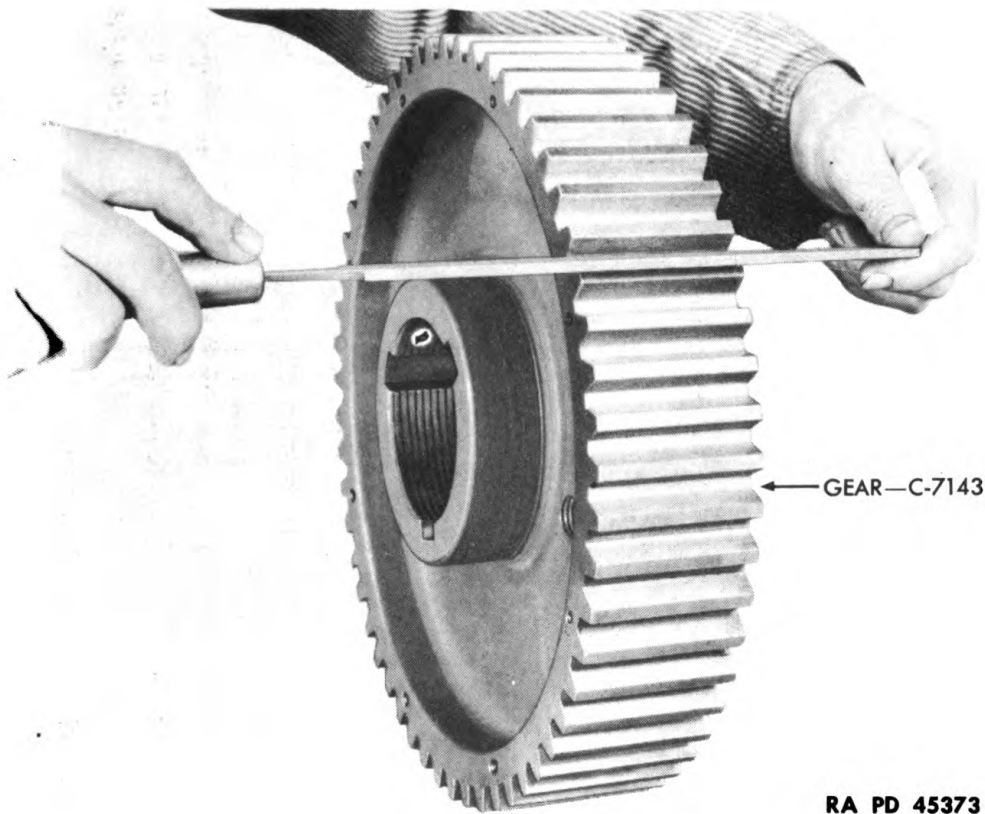


Figure 184—Elevating Handwheel Gear Mechanism

ELEVATING MECHANISM



RA PD 45373

Figure 185—Filing Elevating Shaft Gear Teeth

is toward the bearing. The closure must be tight against the shoulder on the shaft and the bearing tight against the closure. After cooling, pack the bearing with grease. Work grease well into bearing rollers.

(2) If an arbor press is not available, tap the shaft into closure and bearing, using a round steel block 9 inches high with a $3\frac{5}{8}$ -inch diameter hole through it, a hammer, and wood block (fig. 182).

b. Assemble Elevating Mechanism Group.

(1) Coat the elevating brake drum shaft and bearing seat in the elevating handwheel gear housing with grease. Slide the elevating brake drum shaft into place in elevating handwheel gear housing. Tap bearing, closure, and shaft into place if necessary. Insert the two brake drum keys into place in brake drum shaft.

(2) Push or tap the chrome leather seal on the hub of the brake drum with open leather edge of seal out so it will be toward the bearing in the housing (fig. 193).

(3) Coat the inside of the brake drum hub with grease. Slide drum into position on shaft and keys. Slide shaft sleeve in position on shaft. Install elevating clutch shoe in drum and housing with one of three

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

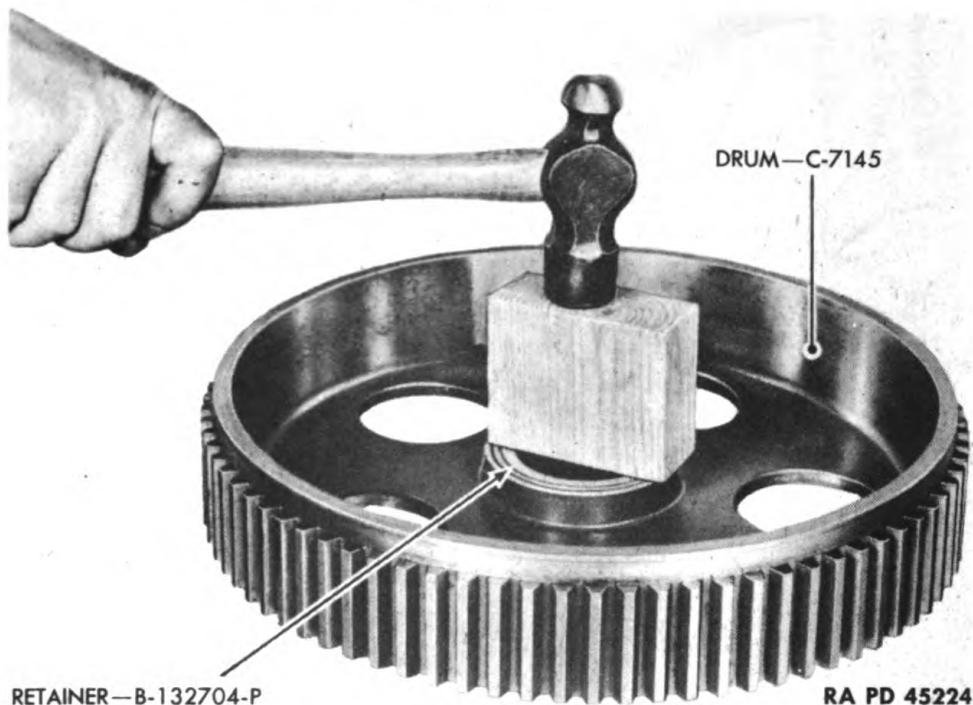


Figure 186—Installing Retainer in Elevating Brake Drum

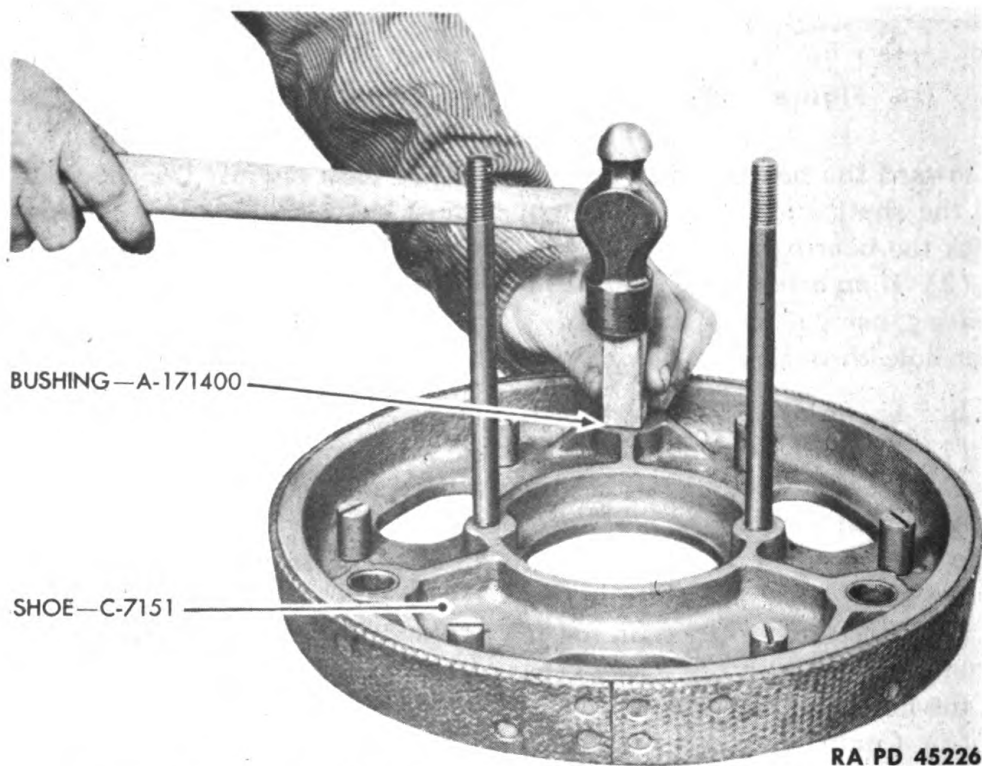


Figure 187—Installing Bushing in Elevating Clutch Shoe

ELEVATING MECHANISM

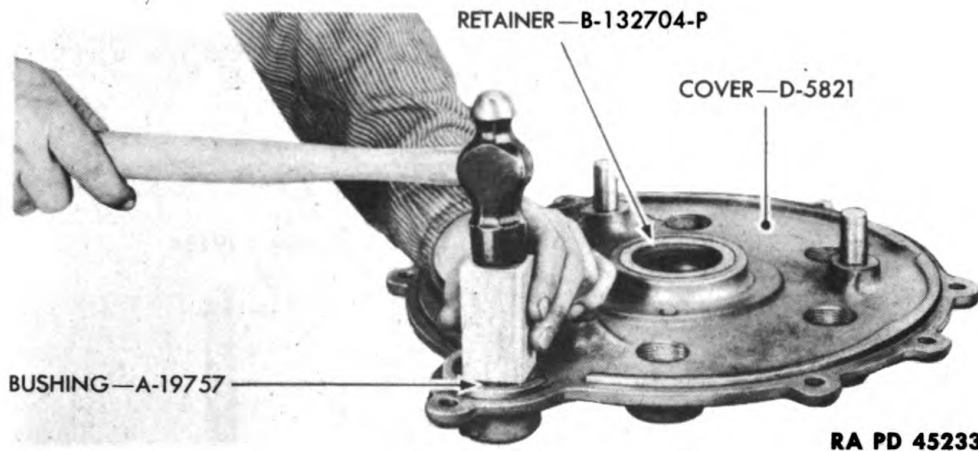


Figure 188—Installing Bushing in Elevating Handwheel Gear Housing Cover

elevating clutch shoe guide pin holes (with bushings) in line with the elevating handwheel pinion hole in housing (fig. 194).

(4) Coat elevating handwheel pinion where it fits into bushings A19757 with grease. *One bushing is in housing and one in cover.* Insert handwheel pinion in place in housing with pinion in mesh with drum teeth. Then slide the housing cover in place, tapping lightly to force it down over three elevating clutch shoe guide pins (fig. 195). Make sure cover is up tight against housing. Coat threads of six cover retaining screws with COMPOUND, rust-preventive, light, and install with washers.

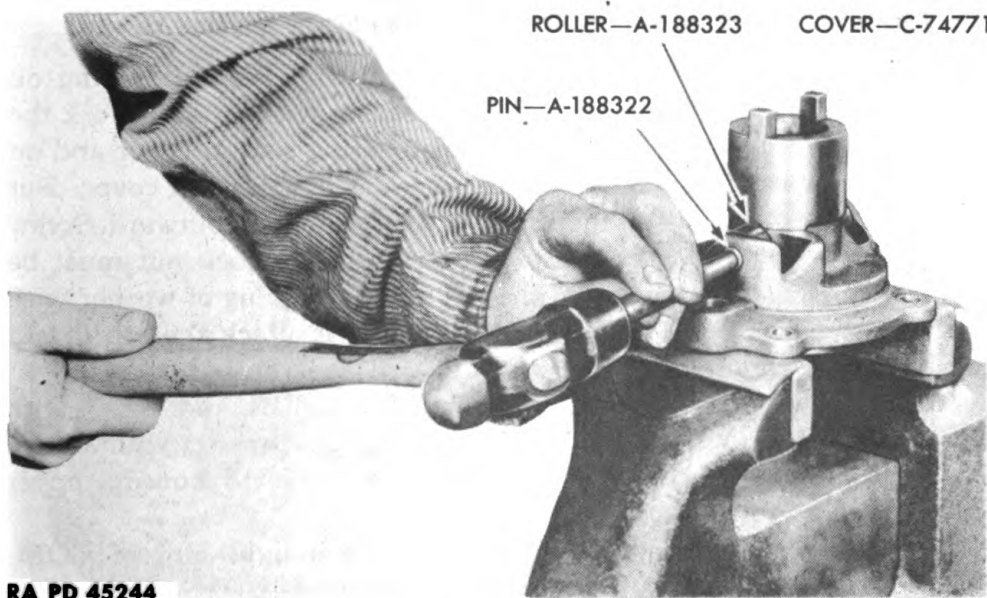


Figure 189—Removing Pin and Roller from Elevating Brake Drum Shaft End Cover

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

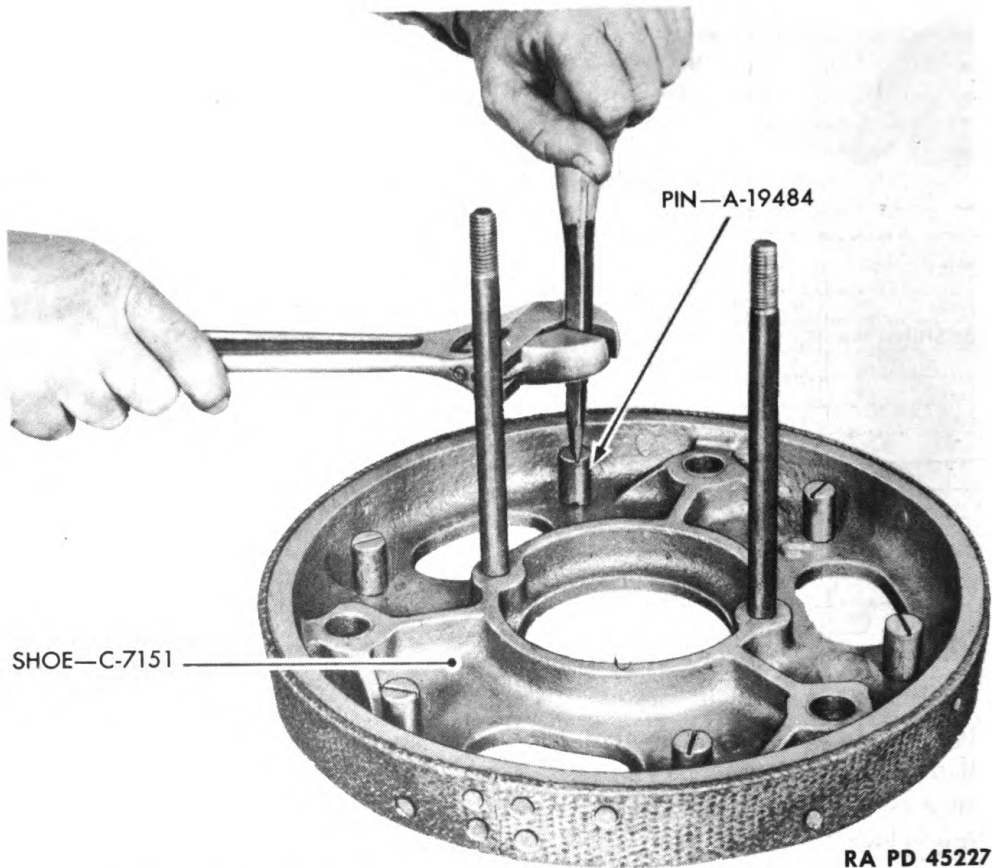


Figure 190—Removing Pin from Elevating Clutch Shoe

(5) Turn the housing and cover assembly up on end, resting on pinion. Pack the brake drum shaft ball bearing with grease. Work the grease well into balls and races. Coat the bearing seat in cover and on shaft with grease. Tap the bearing in place on shaft and in cover. Put the lock washer in place on the shaft with lugs inclined outward. Screw the lock nut on the shaft. The tapered side of the lock nut must be next to the lock washer. Tighten the nut and line up lug of washer with slot in lock nut. Bend lug down into slot in nut. Pack the top of nut and bearing with grease (fig. 175).

(6) Pack recess in bottom of brake drum shaft end cover with grease. Coat the four end cover retaining screw threads with COMPOUND, rust-preventive, light. Secure end cover to housing cover with four screws and washers.

(7) Coat the six brake shoe springs with a light film of COMPOUND, rust-preventive, light, and install on the six spring guide pins in the elevating clutch shoe (figs. 178 and 196). Place brake shoe spring washers on top of springs. Coat the threads of the six spring

ELEVATING MECHANISM

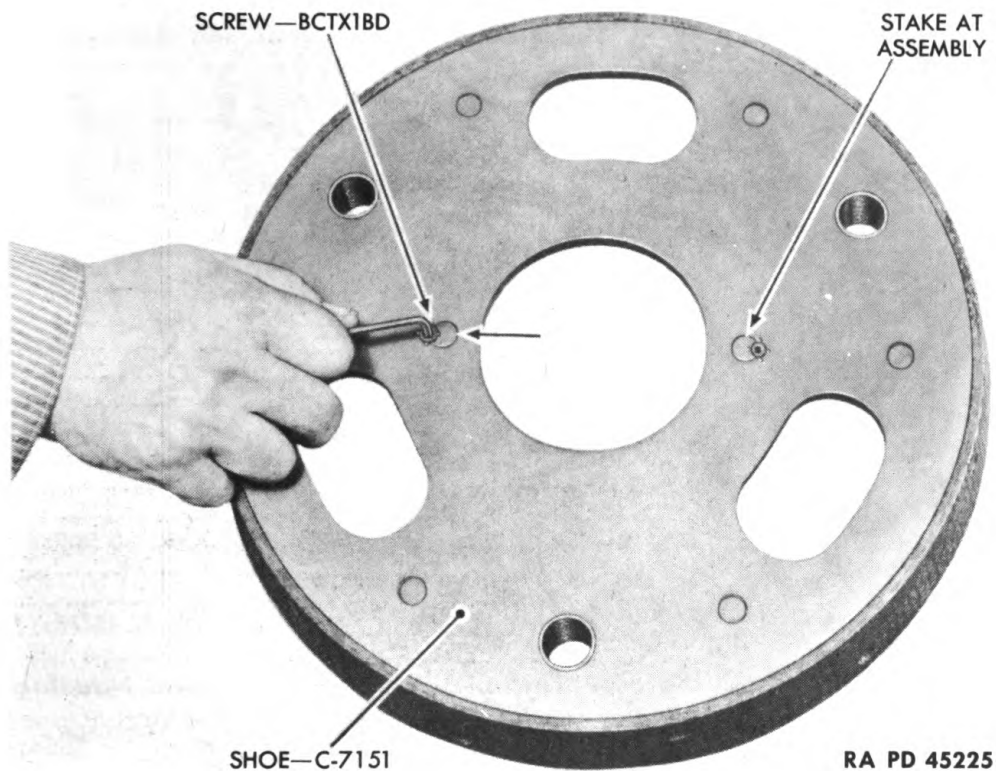


Figure 191—Removing Set Screw from Elevating Clutch Shoe and Stud

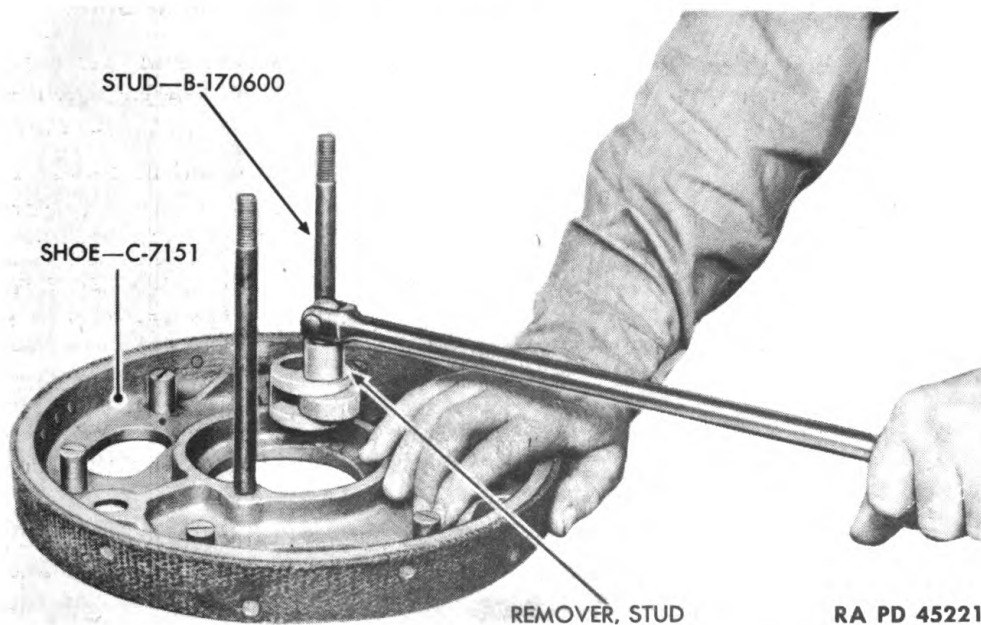


Figure 192—Removing Stud from Elevating Clutch Shoe

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

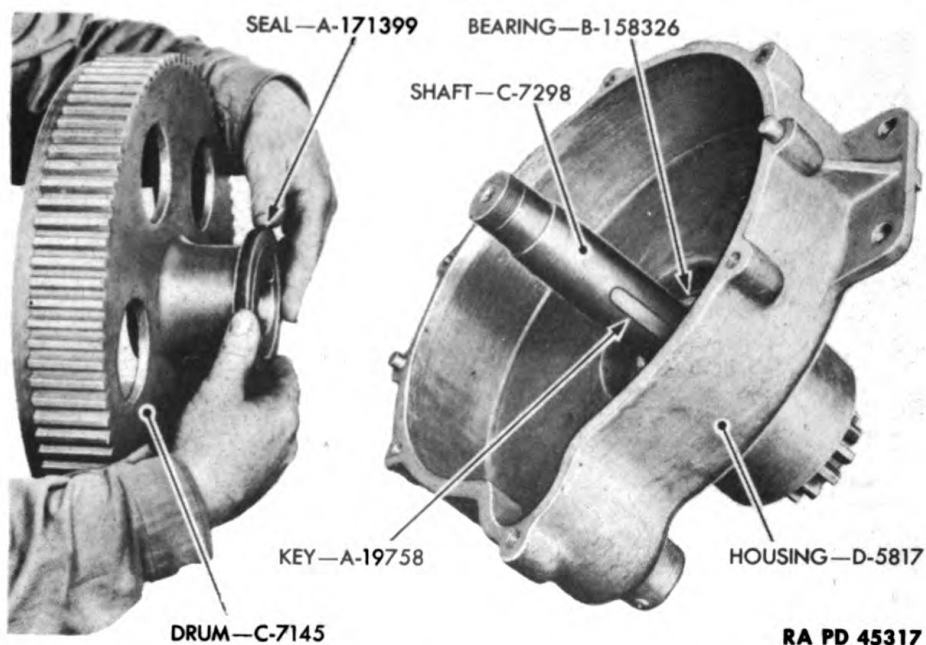


Figure 193—Assembling Elevating Brake Drum, Shaft and Housing

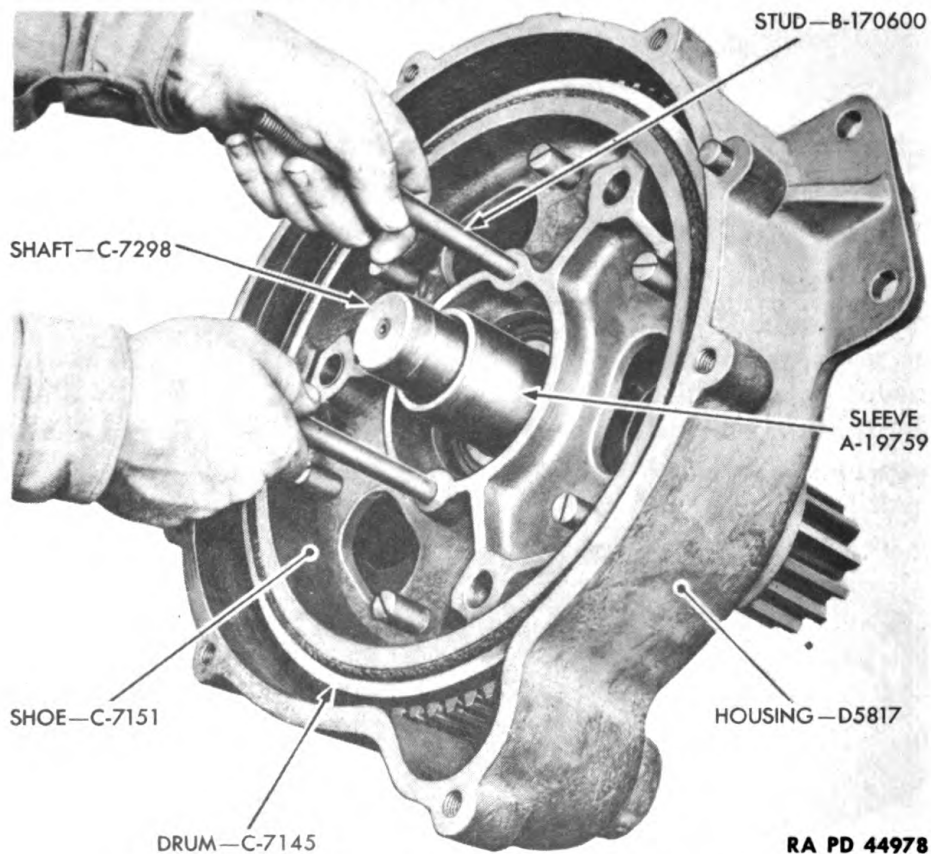
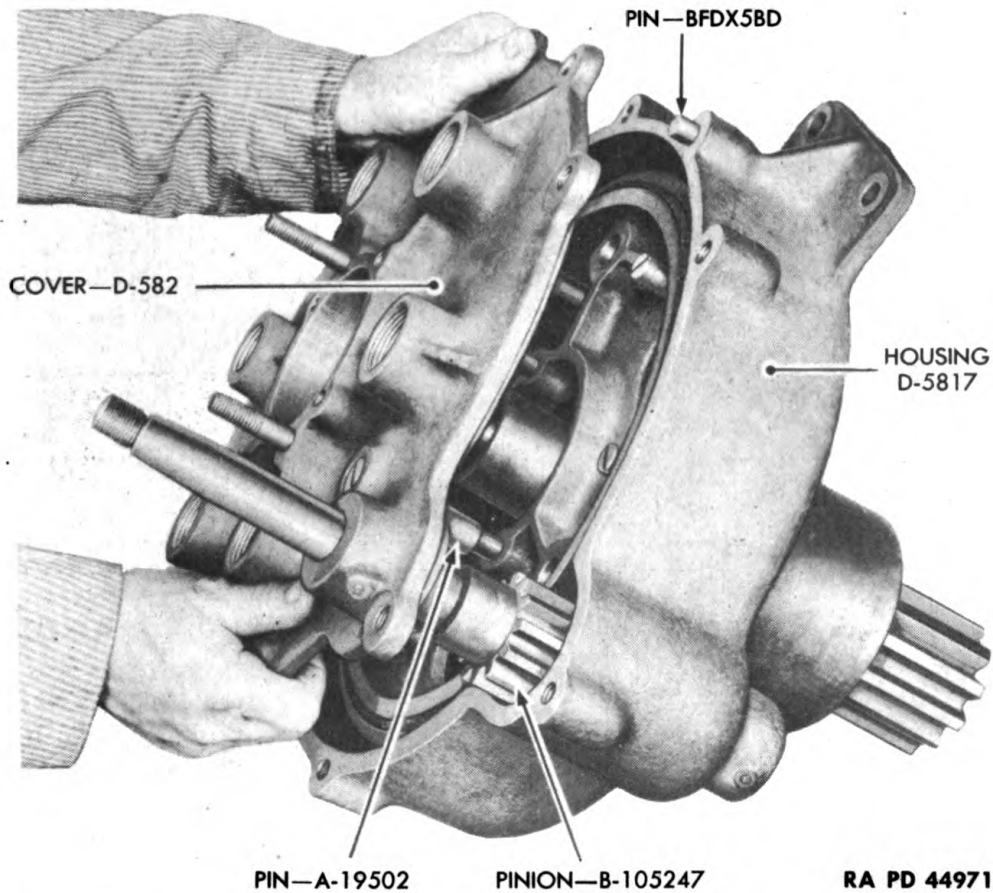


Figure 194—Installing Elevating Clutch Shoe
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ELEVATING MECHANISM



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Figure 195—Installing Cover on Elevating Handwheel Gear Housing

retaining plugs and plug openings in cover with COMPOUND, rust-preventive, light. Install plugs in cover.

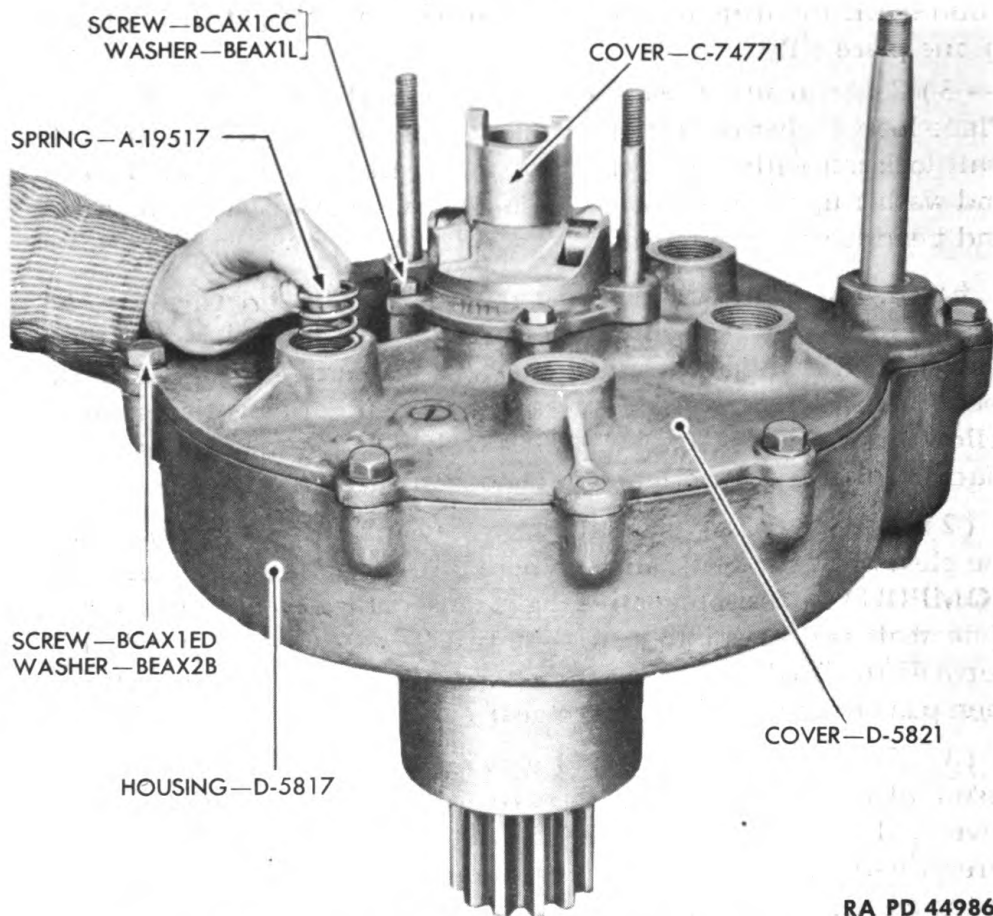
(8) Coat the hub of the brake drum shaft end cover and rollers with OIL, engine (seasonal grade). Slide the elevating mechanism clutch lever assembly on the end cover. Place the elevating mechanism yoke on the two yoke studs (fig. 173). Coat threads of studs with COMPOUND, rust-preventive, light. Secure yoke in position with two nuts and washers.

(9) Place the limit lock in position on the elevating mechanism clutch yoke. Coat threads of lock screw with COMPOUND, rust-preventive, light, and install it in the end of the lock.

(10) Coat the threads and tapered end of elevating handwheel pinion with COMPOUND, rust-preventive, light. Install key in shaft. Tap the elevating handwheel in place on shaft and key. Secure with nut and washer (fig. 172).

c. **Assemble Bearings and Seals on Elevating Shaft.** Replace bearings and seals on elevating shaft as described in paragraph 74.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44986

Figure 196—Inserting Elevating Clutch Shoe Spring

74. MOUNT ELEVATING MECHANISM ON TOP CARRIAGE.

a. Assemble Elevating Shaft.

(1) If the retaining ring B158241, seal A171326, and roller bearing B104910 on the left end of elevating shaft C7142 have been removed (fig. 183), replace these parts as described in step (2) below. If the ring, seal, and bearing on the left end of the shaft have not been removed, proceed with step (3) below.

(2) To facilitate assembly of the left bearing, rotate while clamping to insure that rollers are properly seated against cone rib. Heat entire bearing in OIL, engine, SAE 30, at about 305 F for 1¼ hours. Then press or tap the roller bearing together with retaining ring and seal in place on the shaft. After cooling, pack roller bearing with grease, working grease well into rollers. The open leather edge of the seal must face the bearing and the ring *must* be against the shoulder on the shaft and the bearing up against the ring. **NOTE:** When installing

ELEVATING MECHANISM

bearing, stand the shaft on end on a wood block. Drive bearing on with wood block and hammer. Be sure to drive it on straight. Do not strike in one place only.

(3) Coat threads on shaft with **COMPOUND**, rust-preventive, light. Place lock washer on left end of shaft with lugs inclined outward. Install lock nut with the tapered side facing the lock washer. Draw nut and washer up against bearing. Line up slot in nut with a lug on washer and bend lug down into slot.

b. Install Elevating Shaft and Gear in Top Carriage.

(1) Insert the elevating shaft through opening in left side of top carriage and let pinion rest in opening of top carriage (fig. 170). Slide the elevating gear cover ring over the right end of elevating shaft and follow with elevating gear cover seal. **NOTE:** Install seal with large diameter flange toward left side of top carriage (fig. 197).

(2) Coat the three elevating gear keys, the elevating shaft where the elevating gear seats, and the bore of the elevating shaft gear with **COMPOUND**, rust-preventive, light. Insert the keys in the shaft and slide shaft and keys into gear. Use two 2- x 4- x 6-inch wood blocks between the inside right face of the top carriage and the elevating gear; then push or drive the shaft into gear (fig. 197).

(3) Pull elevating shaft and gear back to the left far enough to install elevating gear cover (fig. 170). Paint mating surfaces of gear cover and top carriage with **LEAD**, white. Coat threads of six retaining screws with **COMPOUND**, rust-preventive, light. Secure gear cover to top carriage with the retaining screws and washers.

(4) Slide the elevating shaft and gear to the right so that the roller bearing on the left end starts to enter the opening in the top carriage. While another man guides the right end of the shaft into the opening in the right side of the top carriage, drive the shaft and bearing into place. Use a large wood block, 4 x 30 inches, and strike straight against left end of elevating shaft (fig. 198).

(5) Insert a brass bar, $\frac{1}{2}$ x 4 x $7\frac{1}{16}$ inches, between the elevating shaft pinion and left side of top carriage (fig. 199). Install right roller bearing B104910, retaining ring B158241, and seal A171326 (fig. 183) by following same procedure as outlined for left-hand bearing, using **OIL**, engine, SAE 30, to preheat bearing. **NOTE:** Install bearing seal with open leather edge toward the bearing and up against the shoulder on the shaft.

(6) Coat the shaft threads with **COMPOUND**, rust-preventive, light. Slide the lock washer into position on right end of shaft with lugs inclined outward. Screw the lock nut on shaft with tapered side of nut next to washer. Draw nut up tight, line up slot in nut with lug and bend

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

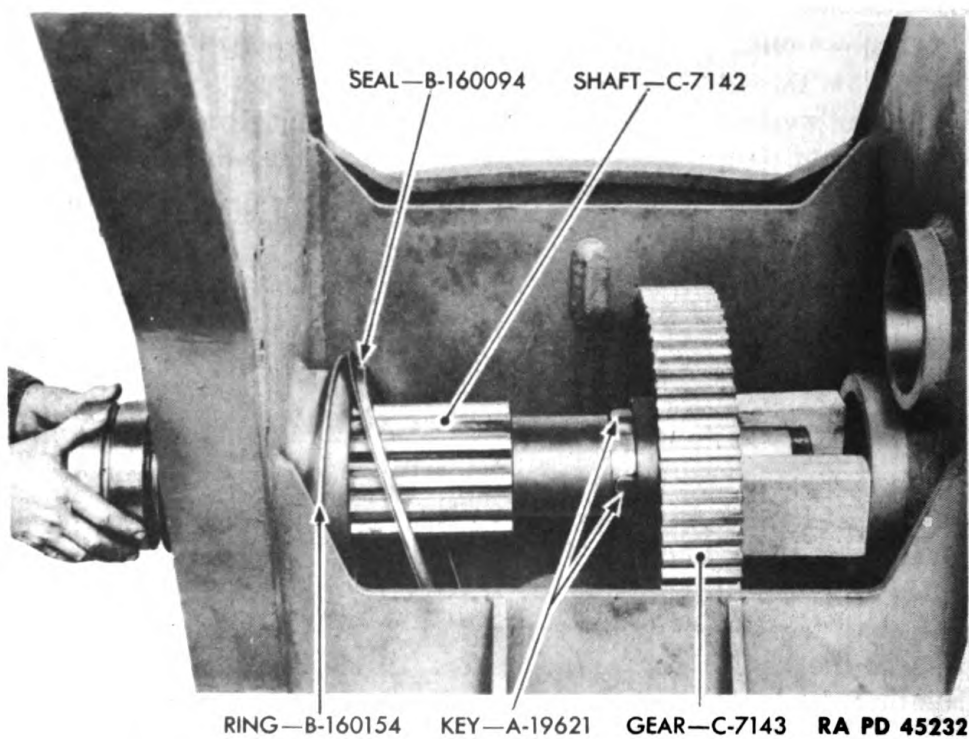


Figure 197—Installing Elevating Shaft Gear

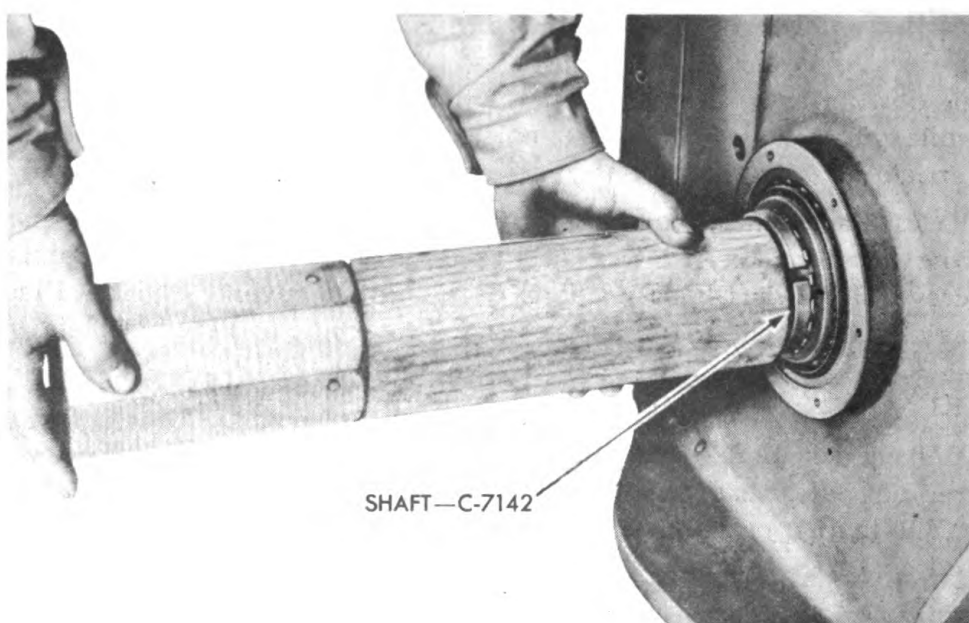


Figure 198—Installing Elevating Shaft

ELEVATING MECHANISM

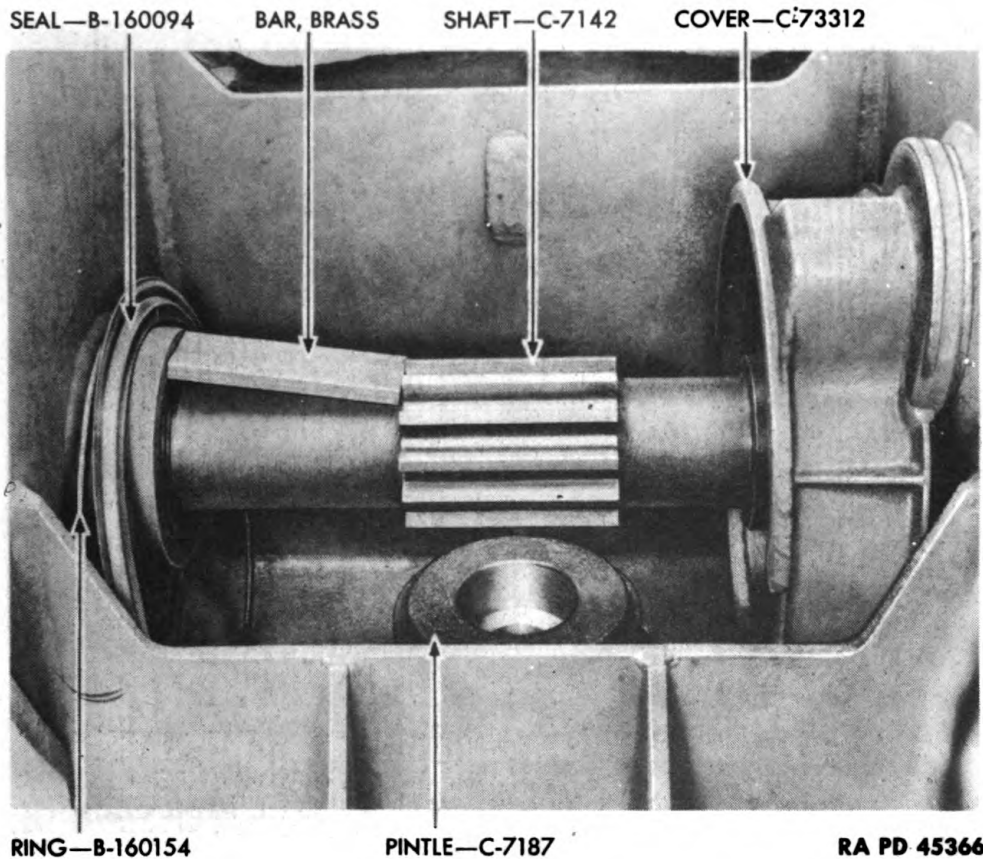


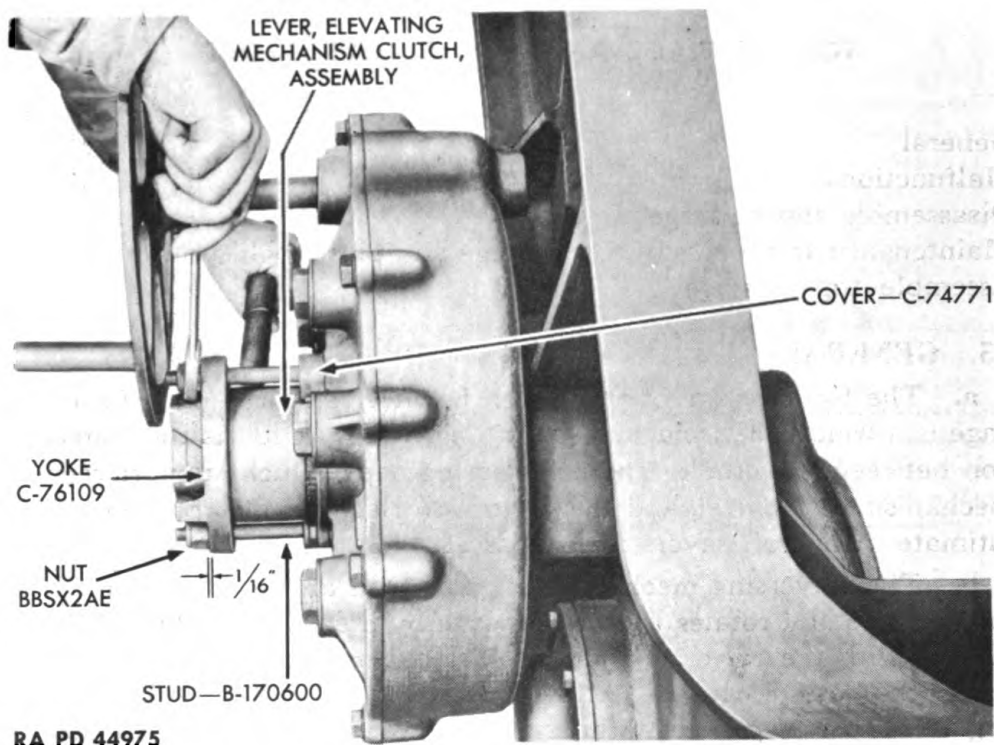
Figure 199—Centering Elevating Shaft

lug down into slot. Another man will have to hold shaft from turning while nut is tightened. Use small pinch bar between pinion and top carriage. Remove brass bar.

(7) Pack grease around bearings and lock nuts on each end of shaft. Coat threads of eight elevating gear cover seal and ring retaining screws BCGX1.1BF with COMPOUND, rust-preventive, light. Place the elevating gear cover seal and ring in position, and secure to elevating shaft gear with the retaining screws and washers (figs. 168 and 183).

(8) Pack both elevating shaft end cover caps B104914 with grease. Coat threads of 12 end cover cap retaining screws with COMPOUND, rust-preventive, light. Place the brass end cover cap shims and caps in place and secure with retaining screws and washers (fig. 183). **NOTE:** These laminated brass shims are used only as required to obtain a total clearance of $\frac{1}{8}$ inch between cap flanges and roller bearing cups on elevating shaft. The clearance for the cap mounted on the right side should be a $\frac{1}{16}$ -inch minimum.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44975

Figure 200—Adjusting Elevating Brake Clutch Operation

(9) Coat the mating surfaces of elevating handwheel gear housing and top carriage with **LEAD**, white. Coat threads of two housing retaining screws with **COMPOUND**, rust-preventive, light. Place the elevating handwheel gear mechanism assembly in position on top carriage and secure with two retaining screws and washers (fig. 165).

(10) Install lubrication nipple and fitting in inside bottom of top carriage (fig. 163).

(11) Check operation of elevating mechanism brake by operating the elevating mechanism clutch lever assembly. There should be a clearance of $\frac{1}{16}$ inch between elevating mechanism clutch yoke and stud nuts to provide proper end play for lever on end cover (fig. 200). Release the brake, and turn elevating handwheel to test mechanism for free and smooth action.

Section XVII

TOP CARRIAGE AND PINTLE BOLT GROUP

	Paragraph
General	75
Malfunctions	76
Disassemble top carriage	77
Maintenance and repair of top carriage and pintle bolt group ..	78
Assemble top carriage	79

75. GENERAL.

a. The top carriage of the 8-inch howitzer and 155-mm gun carriage is a welded and machined unit (fig. 201). It forms the connection between the cradle trunnion bearing caps, which support recoil mechanism and barrel, and the bottom carriage. It also provides the ultimate means of traversing the barrel.

b. The traversing mechanism is assembled to the left side of the top carriage and rotates the top carriage by means of a pinion which meshes with the traversing arc. The traversing arc is secured to the top of the bottom carriage. A large steel bolt C68849, the pintle bolt (fig. 202), passes vertically through the pintle and pintle thrust bearing. The pintle, mounted in the center of the top carriage, extends down into the pintle bushing in the bottom carriage. In operation, the traversing mechanism rotates the top carriage around the bottom carriage, the pintle around the pintle bolt, and the large roller bearing between the top and bottom carriages.

c. The elevating mechanism, with the exception of the elevating arc, is also attached to the top carriage (figs. 163 and 164).

76. MALFUNCTIONS.

a. Difficult to Traverse.

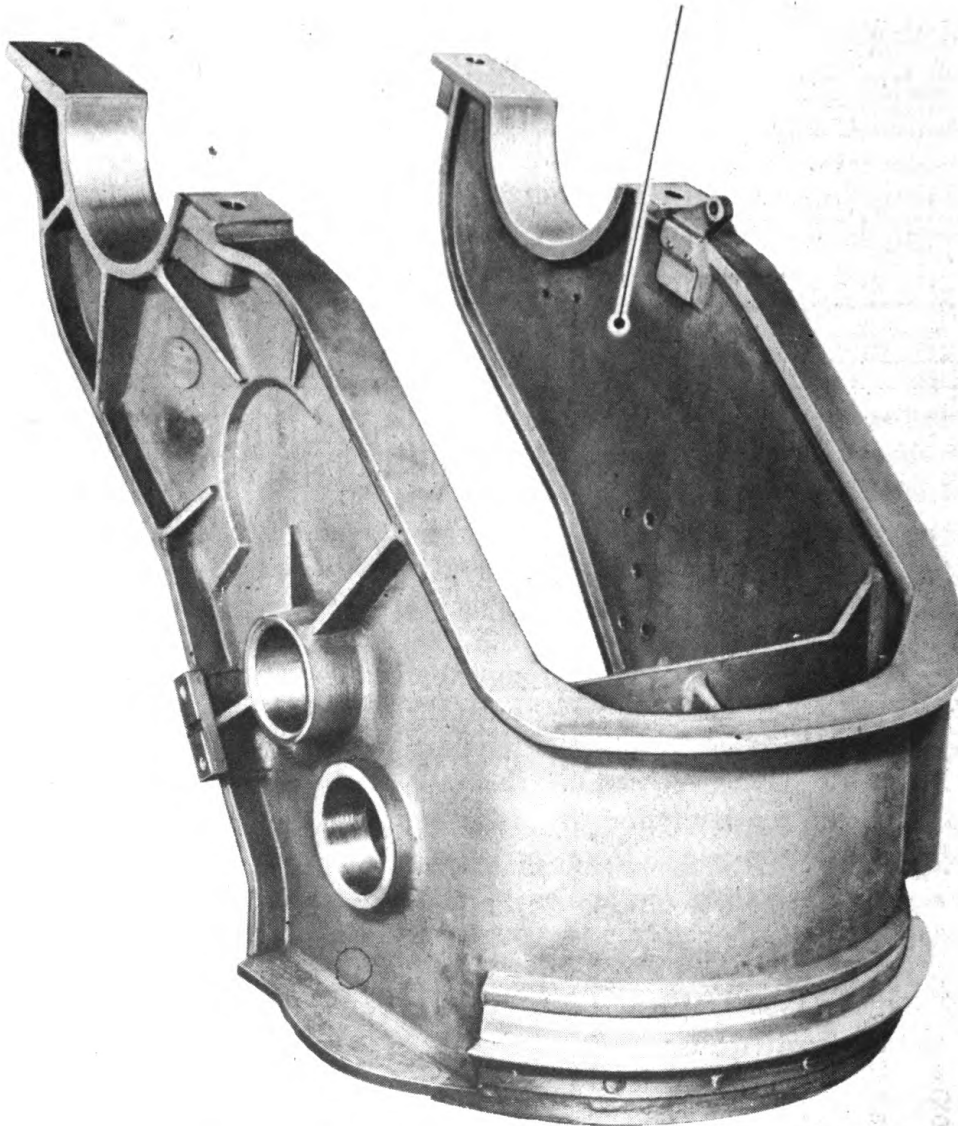
Cause	Correction
Binding of pintle and pintle bolt.	Disassemble and check for scored or damaged pintle, pintle thrust bearing, or pintle bushing in bottom carriage. Replace damaged parts (pars. 78 and 83).
See paragraph 62 for other causes.	See paragraph 65 for corrective steps.

77. DISASSEMBLE TOP CARRIAGE.

NOTE: After the top carriage is removed from carriage and the traversing and elevating mechanisms are removed from top carriage

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

CARRIAGE, TOP
D-5818



RA PD 44795

Figure 201—Top Carriage Assembly

(pars. 30, 63, and 70) only the panoramic telescope case and the pintle remain in the top carriage. The pintle can be removed only when the elevating shaft and gear are out of the top carriage (sub-par. a (3) below). The pintle bolt and bearing were removed when the carriage was disassembled (par. 30).

a. Procedure.

- (1) Remove traversing mechanism (par. 63).
- (2) Remove elevating mechanism (par. 70).

TOP CARRIAGE AND PINTLE BOLT GROUP

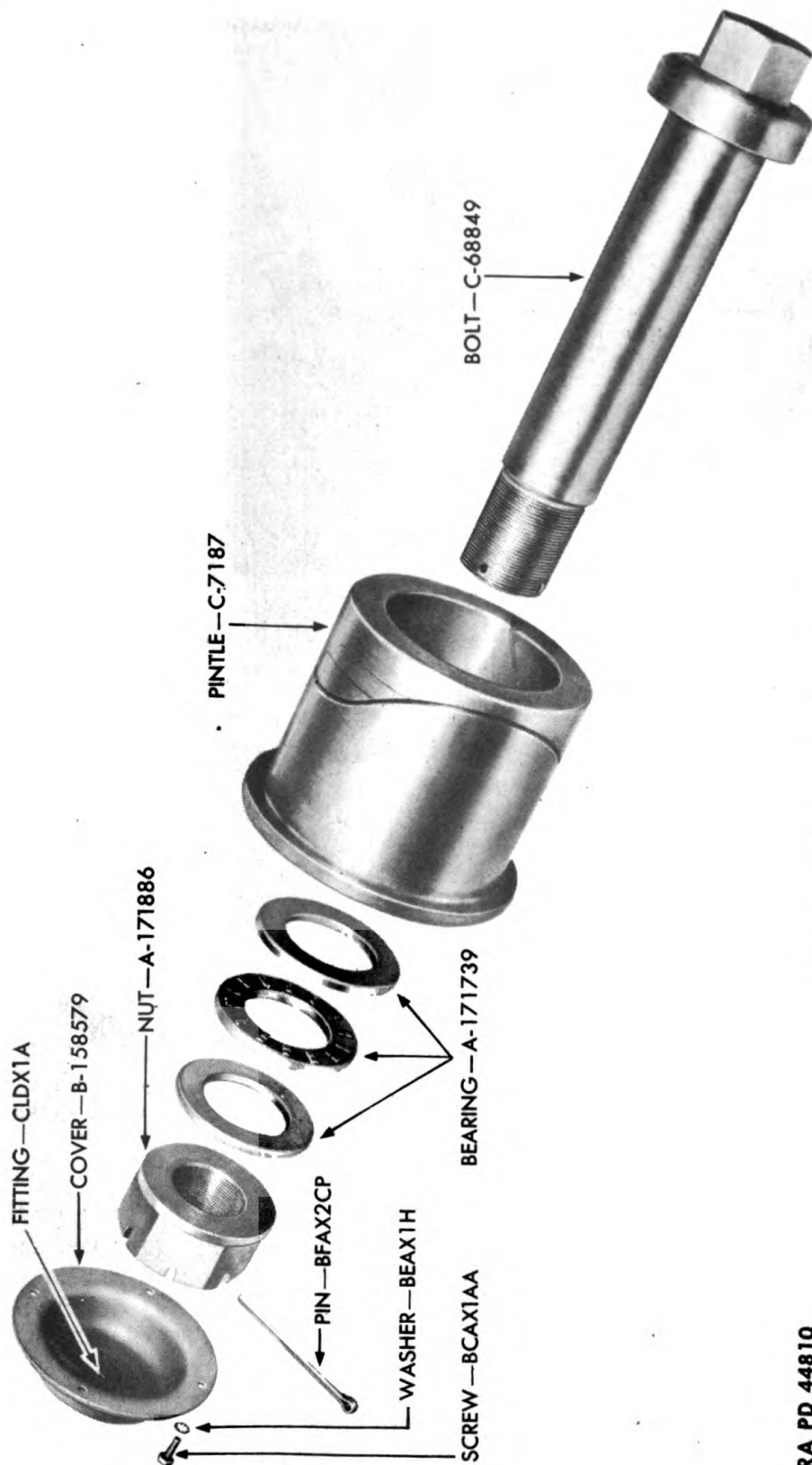
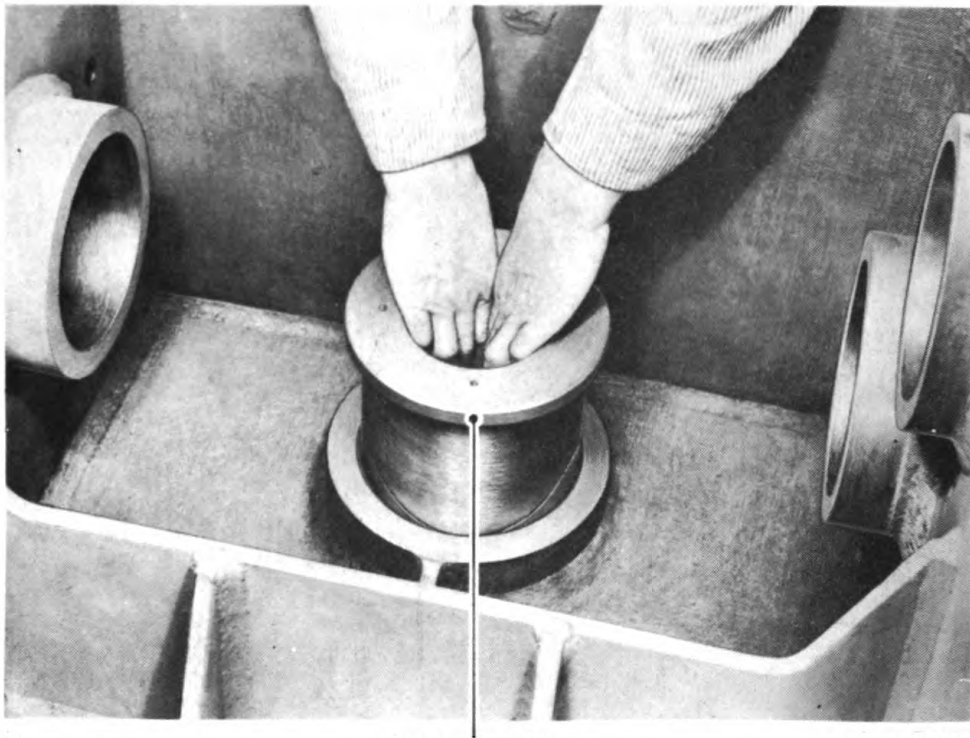


Figure 202 - Pintle Bolt Group

RA PD 44810

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



PINTLE—C-7187

RA PD 45127

Figure 203—Removing Pintle

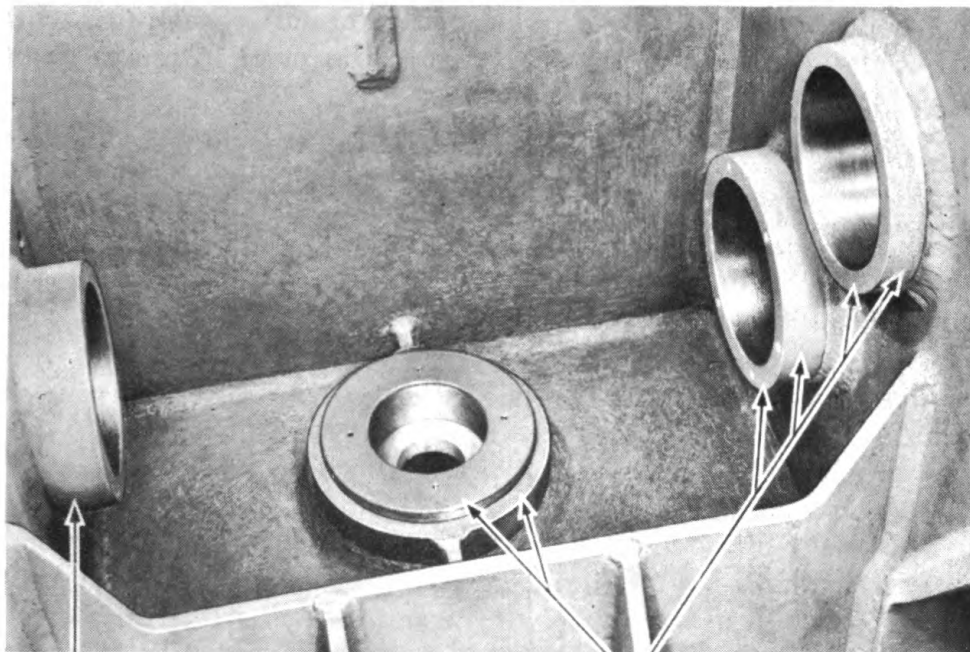
(3) Remove pintle C7187 from top carriage by lifting it straight up, (fig. 203).

**78. MAINTENANCE AND REPAIR OF TOP CARRIAGE
AND PINTLE BOLT GROUP.**

a. Clean top carriage with SOLVENT, dry-cleaning. Examine top carriage for cracks or other damage. Slight damage, insufficient to cause serious damage to the materiel in future service, may be repaired by welding. If damage is serious, replace the top carriage with a new one.

b. Clean the parts of pintle bolt group (fig. 202) in SOLVENT, dry-cleaning. Carefully check the pintle bolt, pintle, and pintle thrust bearing for wear or damage. A scored pintle or pintle bolt can be remedied by carefully scraping, filing and polishing with CLOTH, crocus. Whenever CLOTH, crocus, is used, the part must be washed clean in SOLVENT, dry-cleaning. Small particles from the filing and polishing will act as an abrasive when the pintle and/or pintle bolt are assembled in the top and bottom carriages and will cause excessive wear. Replace all worn or badly damaged parts with new parts.

TOP CARRIAGE AND PINTLE BOLT GROUP

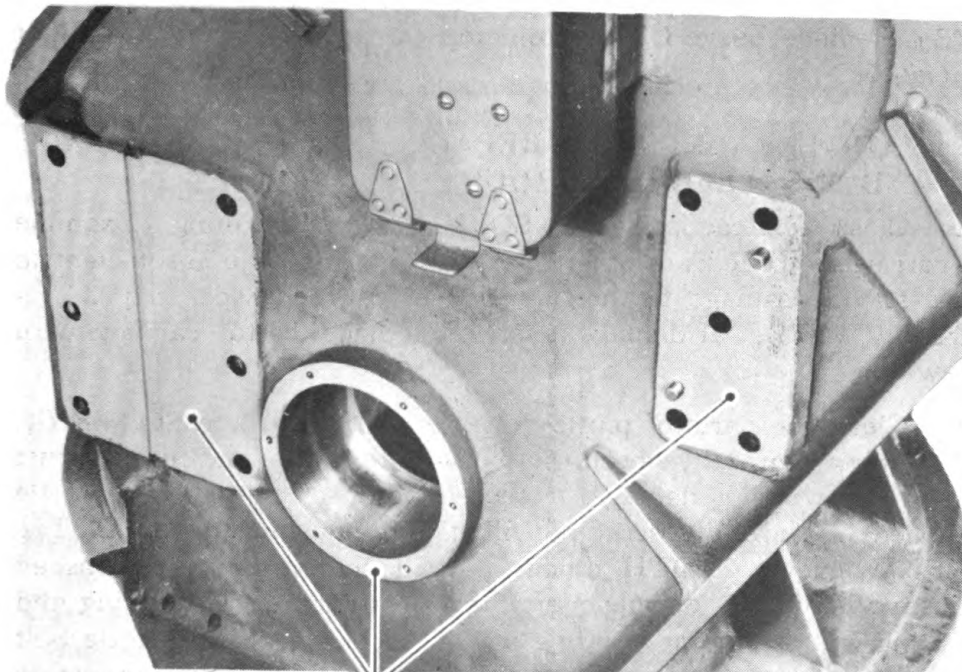


PAINT O. D.

PAINT, PRIMER

RA PD 45073

Figure 204—Preparing Top Carriage for Assembly



PAINT, PRIMER

RA PD 44778

Figure 205—Preparing Top Carriage for Assembly

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

79. ASSEMBLE TOP CARRIAGE.

- a. Lubricate the mating surfaces of pintle and top carriage with OIL, engine (seasonal grade). Insert pintle in place in top carriage (fig. 204).
- b. Paint surfaces as marked with PRIMER, synthetic, rust-inhibiting. Do not get primer paint on top carriage under the pintle flange (figs. 204 and 205).
- c. Install elevating mechanism (par. 74).
- d. Install traversing mechanism (par. 67).
- e. Mount top carriage on carriage (par. 116).

Section XVIII

BOTTOM CARRIAGE

	Paragraph
General	80
Malfunctions	81
Disassemble bottom carriage	82
Maintenance and repair of bottom carriage	83
Assemble bottom carriage	84

80. GENERAL.

a. The bottom carriage of the 8-inch howitzer and 155-mm gun materiel is a welded and machined unit (figs. 206 and 207). It forms the connection between the top carriage and trails. When in the firing position, the bottom carriage rests on the ground and transmits the firing stresses to the ground. When the materiel is in the traveling position, the bottom carriage is suspended on two large pins installed in the bottom of two bogie lifting screws. These pins fit into holes in each side of the front end of bottom carriage.

b. The relay-emergency valve and air reservoir of the air brake system are installed in the front end of the bottom carriage. Air hose lines, connecting the relay-emergency valve and air reservoir to the air brake lines on the trails, run through the bottom carriage.

c. The pintle bushing, top carriage support bearing, Belleville springs and their centering plugs, and the bottom carriage brass liner are assembled to the top of the bottom carriage. The support bearing and Belleville springs increase the rigidity of the pintle bearing and check rebound of the top carriage after firing.

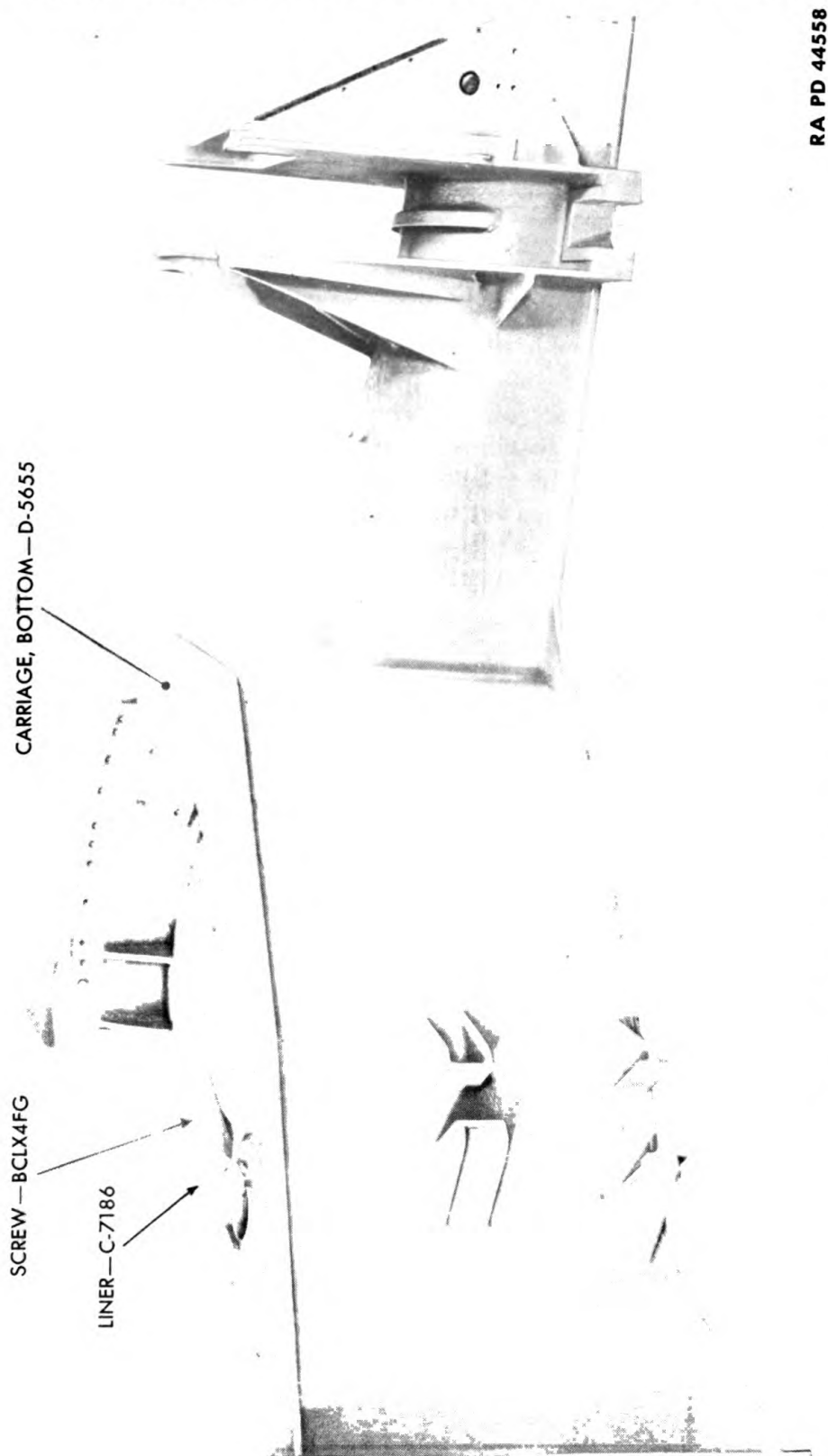
d. The traversing arc is bolted to the top of the bottom carriage. Spade brackets are welded to the sides and rear of the bottom carriage. These brackets support the two front spades when the materiel is in firing position.

81. MALFUNCTIONS.

a. Difficult to Traverse.

Cause	Correction
Binding of pintle in pintle bushing due to scored bushing.	Replace scored pintle bushing (par 83).
Damaged supporting roller bearing.	Repair or replace roller bearing.
See paragraphs 62 and 76 for other causes.	See paragraphs 65 and 78 for corrective steps.
Lack of lubrication.	See section XXV.

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 44558

Figure 206—Bottom Carriage Assembly—Side View

BOTTOM CARRIAGE

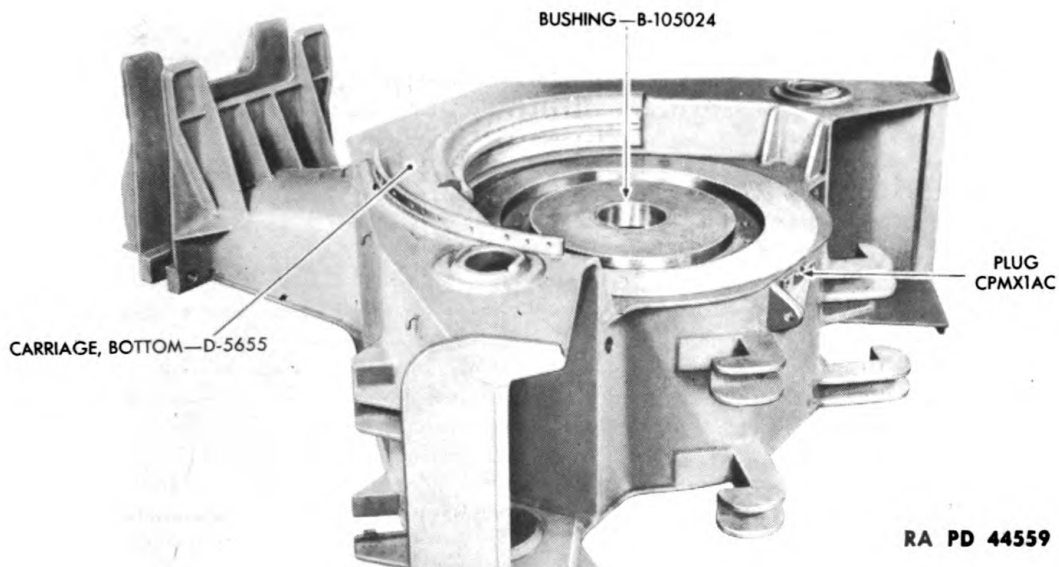


Figure 207—Bottom Carriage Assembly—Rear View

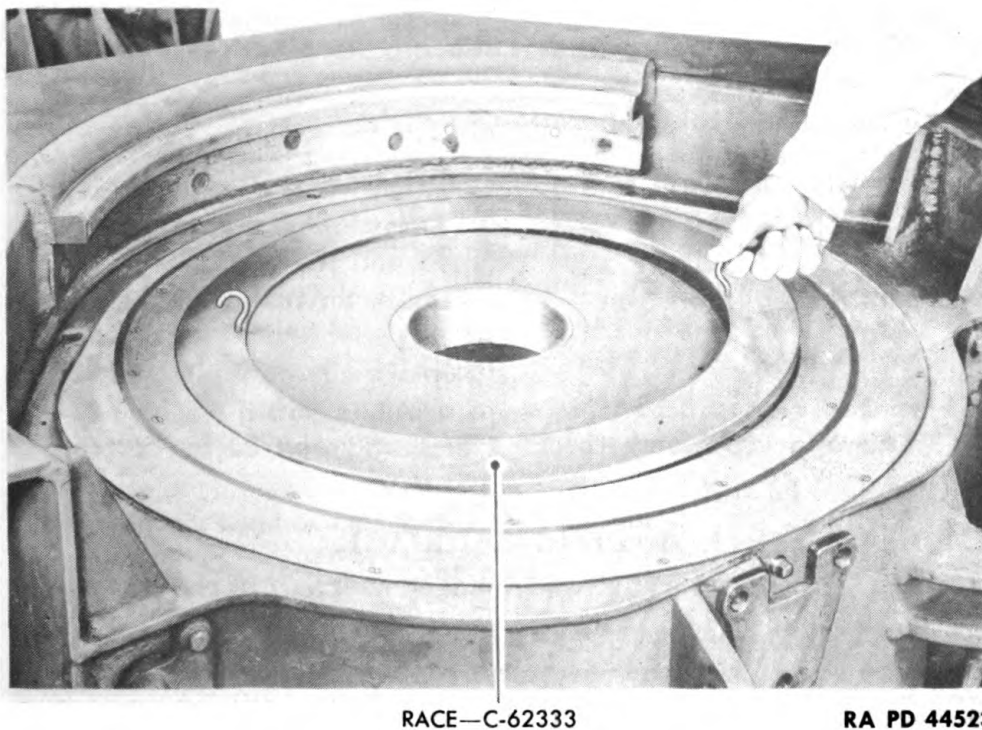
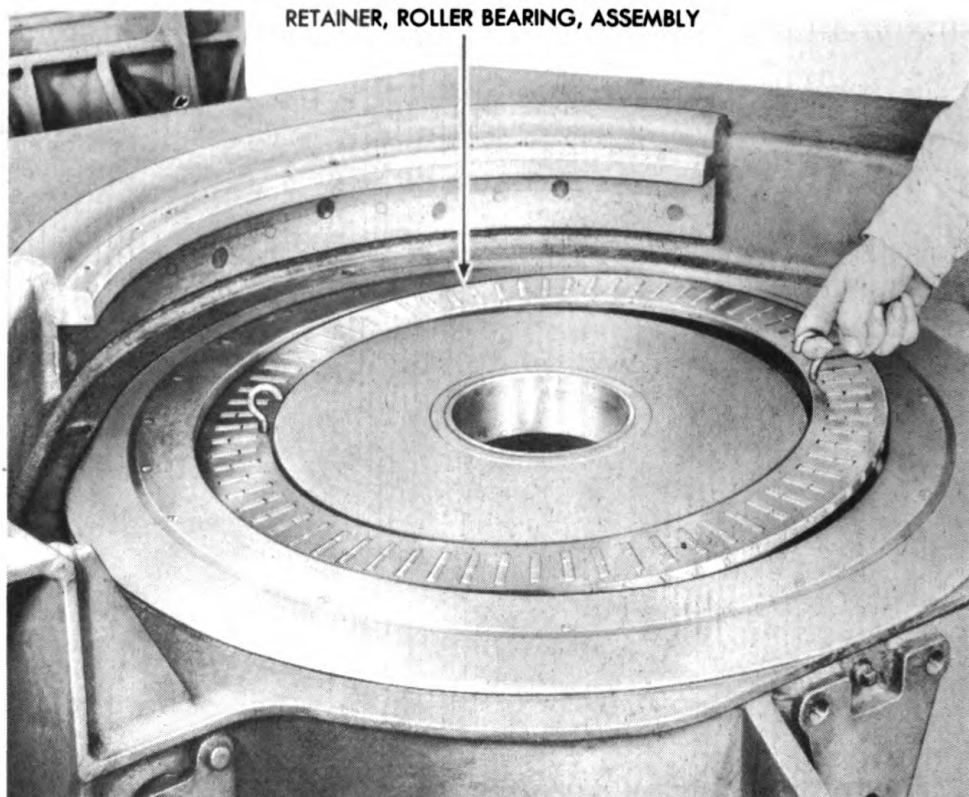


Figure 208—Removing Roller Bearing Upper Race

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44493

Figure 209—Removing Roller Bearing Retainer Assembly

b. Faulty Air Brake Operation.

Cause	Correction
Relay-emergency valve out of order.	Remove relay-emergency valve. Disassemble and repair (pars. 82 and 109).
Leak in air reservoir.	Remove air reservoir (par. 82 d (8)). Replace air reservoir (par. 84 b (4)).
See paragraph 83 for other causes.	See paragraph 83 for corrective steps.

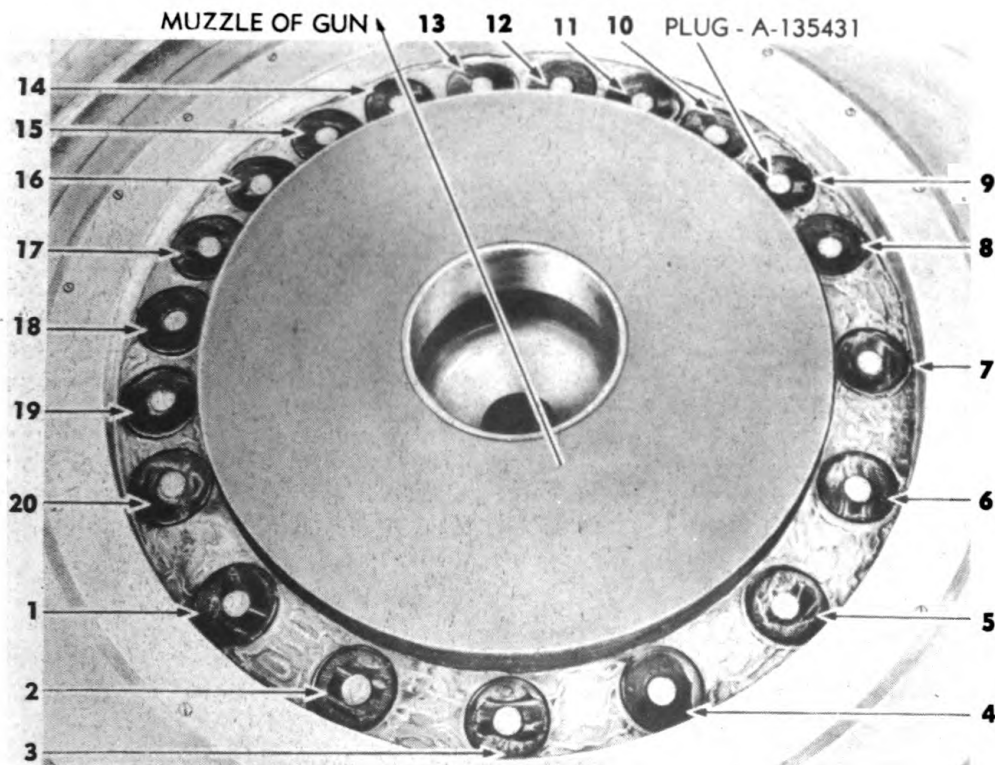
82. DISASSEMBLE BOTTOM CARRIAGE.

NOTE: The traversing arc was removed as a part of the traversing mechanism (par. 63 a).

a. Remove Top Carriage Supporting Roller Bearing.

(1) Screw the two improvised lifting hooks (fig. 25) into threaded holes in race C62333 (fig. 208). Take hold of one hook, then turn and lift upward on the upper race. This will break grease suction between

BOTTOM CARRIAGE



FOR 155-MM GUN CARRIAGE, M1	7 SPRINGS - B158580 NO. 1 TO 7 INCLUSIVE
	13 SPRINGS - B158581 NO. 8 TO 20 INCLUSIVE
FOR 8-IN. HOWITZER CARRIAGE, M1	13 SPRINGS - B158580 NO. 1 TO 7 INCL. 8, 10, 12, 16, 18, 20
	7 SPRINGS - B158581 NO. 8, 11, 13, 14, 15, 17, 19

RA PD 80048

Figure 210—Belleville Springs in Bottom Carriage

upper race and roller section. Lift race out with *both* hooks. **CAUTION:** Avoid injury to race when removing it.

(2) Insert lifting hooks in threaded holes in roller bearing retainer assembly and remove in same manner as top race (fig. 209).

(3) Insert lifting hooks in lower race C62334. Lift one side first, then lift race out with both hooks. Do not rotate this race. **CAUTION:** Exercise care when removing this bearing as it is a precision-finished unit. Surfaces can be easily damaged and are difficult to repair.

b. Remove Belleville Springs. Remove the 20 Belleville springs from the centering plugs A135431 (fig. 210). **CAUTION:** Note how the Belleville springs B158580 and B158581 are located. The 155-mm Gun Carriage M1 has 7 Belleville springs B158580, numbers 1 to 7 inclusive, and 13 Belleville springs B158581, numbers 8 to 20 inclusive (fig. 210). The 8-inch Howitzer Carriage M1 has 13 Belleville springs

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

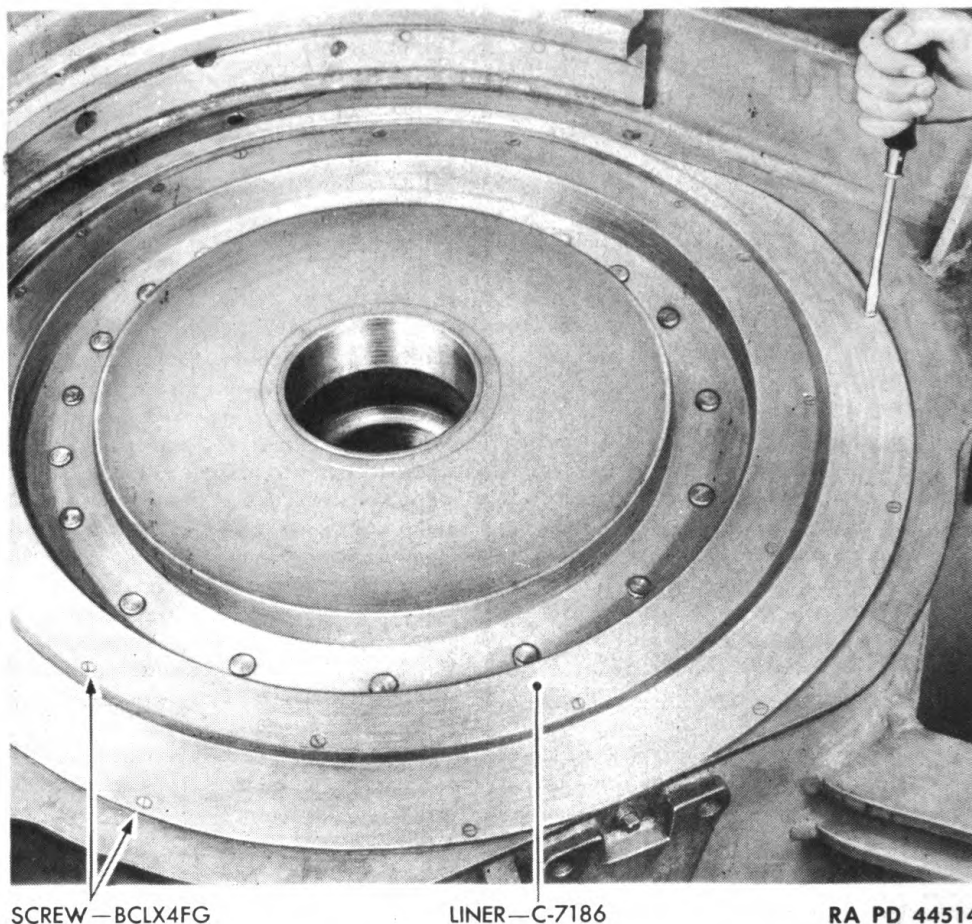


Figure 211—Removing Bottom Carriage Circular Liner

B158580, numbers 1 to 7 inclusive, 8, 10, 12, 16, 18, and 20; and 7 Belleville springs B158581, numbers 9, 11, 13, 14, 15, 17, and 19 (fig. 210).

c. Remove Bottom Carriage Circular Liner.

(1) Remove 24 screws BCLX4FG from brass circular liner C7186 (fig. 211).

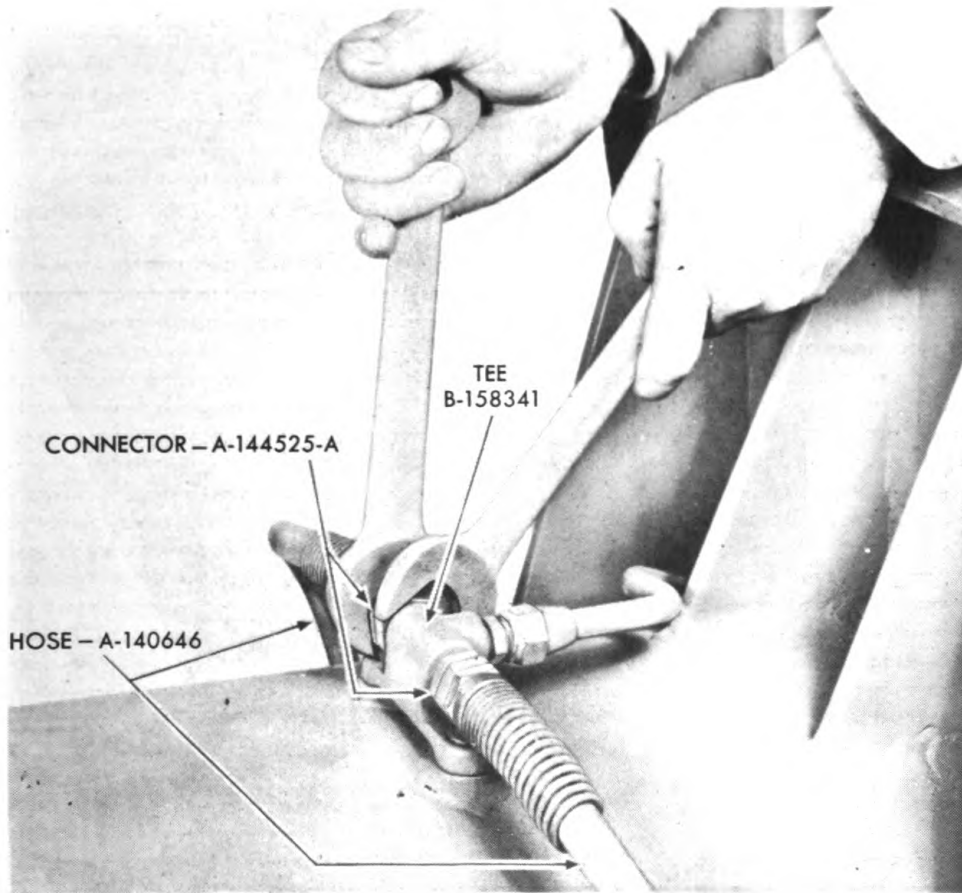
(2) Insert screwdriver between liner and bottom carriage surface, and pry up on liner. Lift liner away from bottom carriage.

d. Remove Relay-emergency Valve, Air Reservoir, Air Hoses, and Tubes.

(1) Disconnect the two connectors A144525A and remove two hoses A140646 from tee B158341 (fig. 212). **NOTE:** These two hoses run from tee to right and left rear air brake diaphragms on bogie.

(2) Disconnect tube A174119B from tee B158341 by disconnecting connector A174057 (fig. 213).

BOTTOM CARRIAGE



RA PD 44515

Figure 212—Disconnecting Brake Air Line Hose at Tee

(3) Remove two screws BCDX2CA, washers BEAX4G, and remove tee B158341.

(4) Remove nine screws BCAX1AA, washers BEAX1H, and remove cover C73117 from bottom carriage (fig. 214).

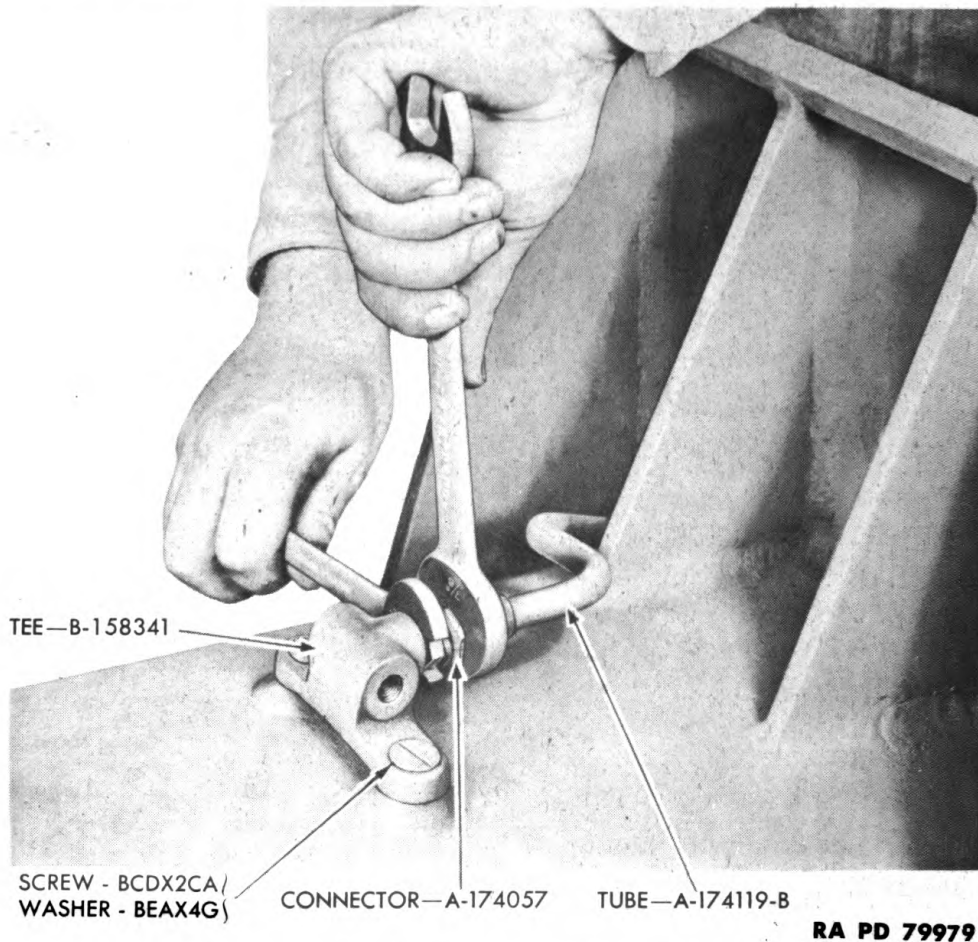
(5) Disconnect hose A140643 at top elbow B7270B and hose A142146 at bottom elbow B7270B (fig. 215).

(6) Disconnect tube A174119B and two tubes A174119A at relay-emergency valve C73678.

(7) Remove two screws BCAX1CD, nuts BBAX1C, washers BEAX1L, and remove valve C73678 (fig. 216).

(8) Remove eight screws BCBX1CD and washers BEAX1L from air reservoir flange (fig. 217). Pull air reservoir C72995 straight out from bottom carriage. Remove gasket B160148. One of the tubes A174119A will come away with reservoir. NOTE: It may be necessary to tap the air reservoir flange lightly with a copper hammer to

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 79979

Figure 213—Disconnecting Tube

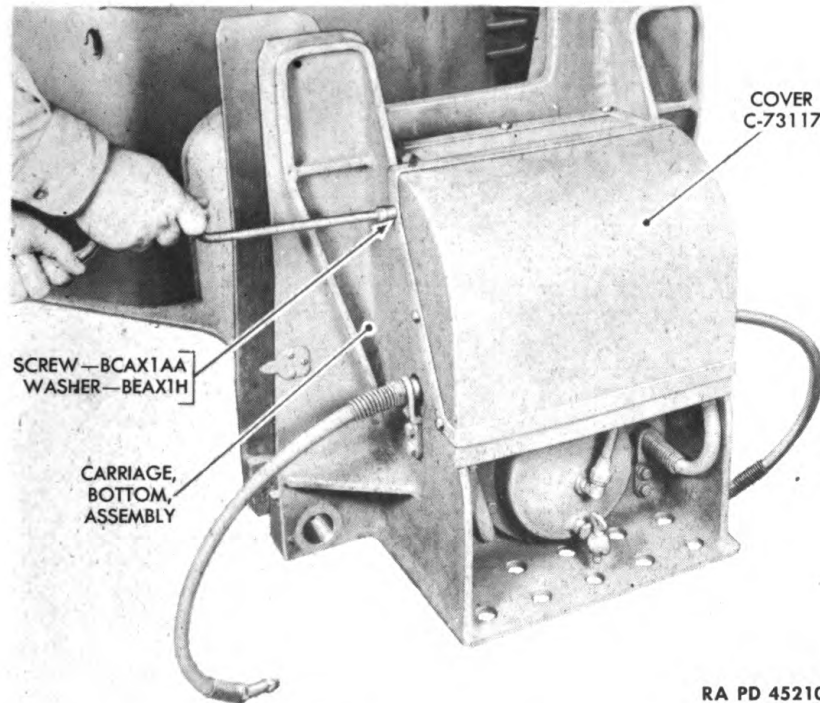
break the seal between the flange and bottom carriage before the reservoir can be removed.

(9) Remove tube A174119A from elbow A174071 (fig. 217). Loosen hose connections of hoses A140646 at tee B158341 (fig. 218). Remove two screws BCBX1CA and washers BEAX1L from bracket B166494. Then remove hose A140646, spring A174035, and bracket B166494 from bottom carriage. Repeat the operations and remove other hose A140646 from bottom carriage. **NOTE:** Air line hoses A140646 run from front tee B158341 to right and left front air brake diaphragms on the bogie. They are identical with the hoses which connect the rear air brake diaphragms with the tee on the top of the bottom carriage (step (1) above).

(10) Remove two screws BCDX2CC, washers BEAX1L, and nuts BBAX1C from tee B158341. Remove tee and elbow A174071 as a unit (fig. 219).

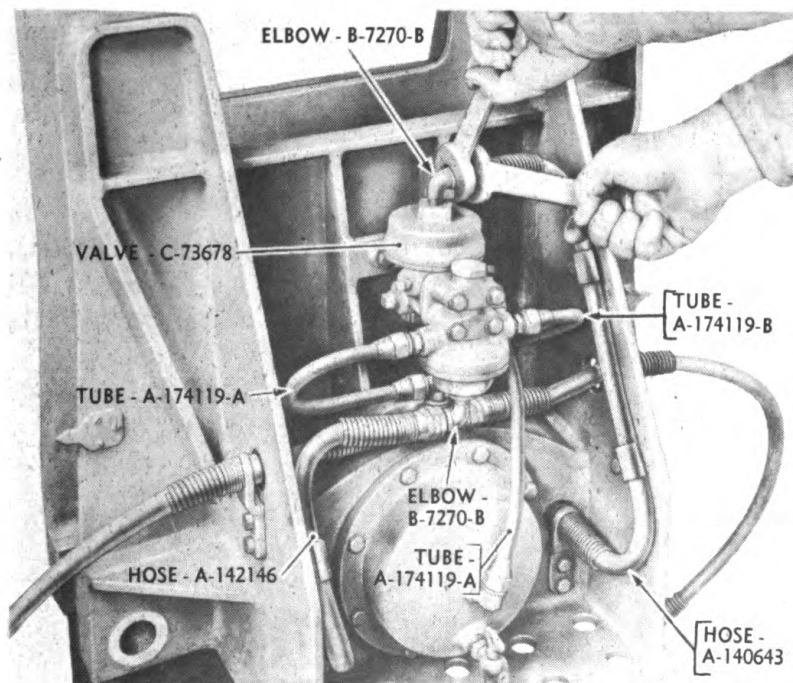
NOTE: Never remove air line hoses A140643 and A142146 and

BOTTOM CARRIAGE



RA PD 45210

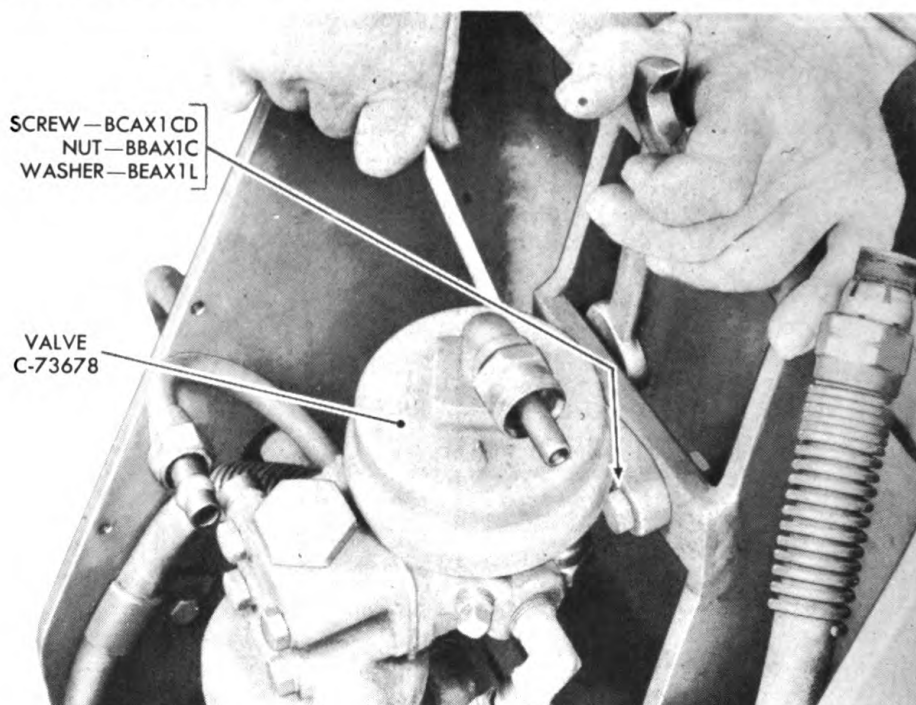
Figure 214—Removing Relay-emergency Valve Cover



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Figure 215—Disconnecting Brake Air Line Hose at Valve

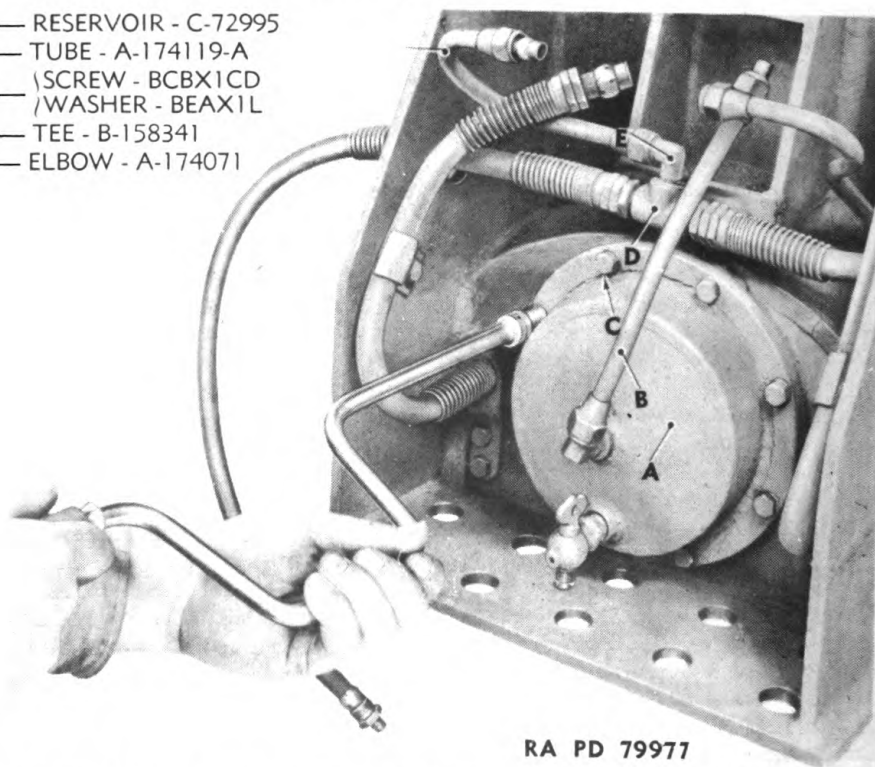
**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 45213

Figure 216—Removing Relay-emergency Valve

- A — RESERVOIR - C-72995
- B — TUBE - A-174119-A
- C — SCREW - BCBX1CD
WASHER - BEAX1L
- D — TEE - B-158341
- E — ELBOW - A-174071



RA PD 79977

Figure 217—Removing Air Reservoir Retaining Screws

BOTTOM CARRIAGE

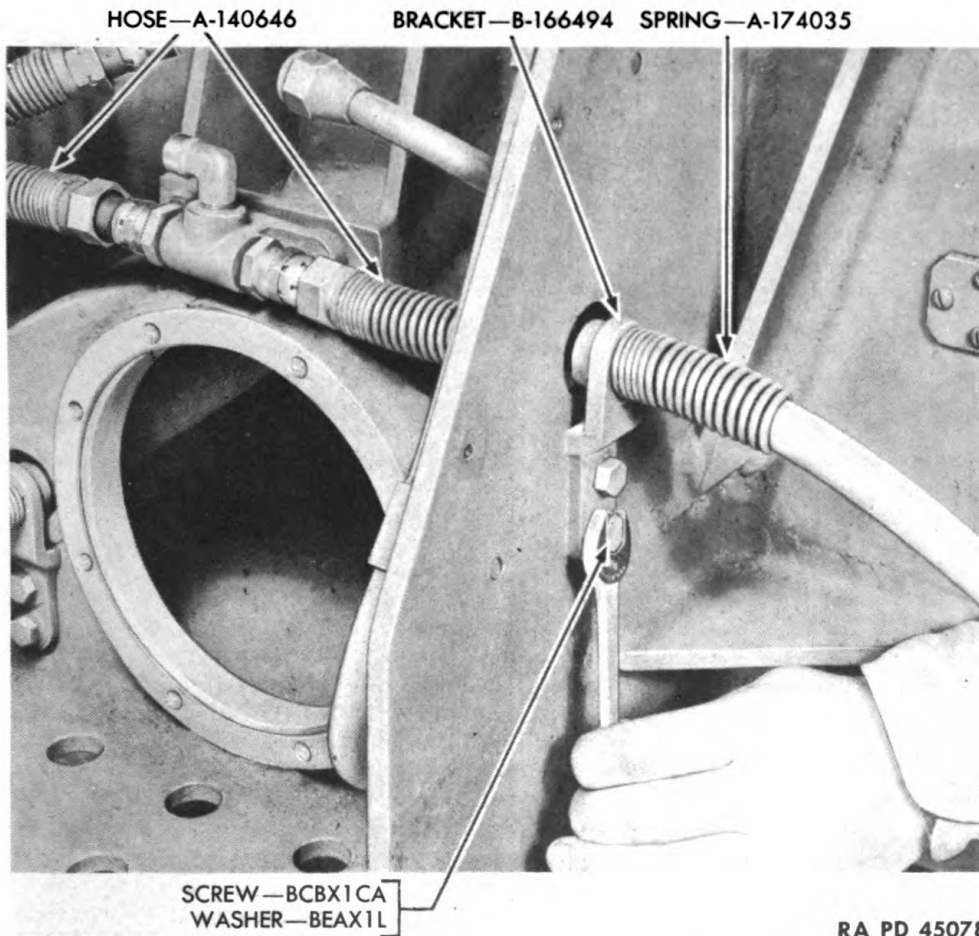


Figure 218—Removing Air Line Hose Support Bracket

tube A174119B (fig. 220) from bottom carriage unless defective or damaged and require replacement. Tube A174119B must be straightened to be removed and hoses must be cut off.

(11) If hoses A140643 and A142146 are defective, remove screws BCBX5E and washers BEAX1L from three hose straps A140641 (fig. 220), and remove straps. Remove four screws BCBX1CA and washers BEAX1L from two brackets B166494 (fig. 220). Cut off end of hose A140643 and A142146 below slotted brass connector ring (fig. 229). Slide two springs A174035, connector nut, and bracket B166494 from each hose.

(12) Remove two screws BCBX1CD and washers BEAX1L from each of the two brackets B166560 mounted on the rear of bottom carriage (fig. 221). Pull hose A142146 or A140643, spring A174035, and bracket B166560 from bottom carriage.

e. Remove plug CPMX1AC from rear of bottom carriage (fig. 207). The bottom carriage is now completely disassembled.

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

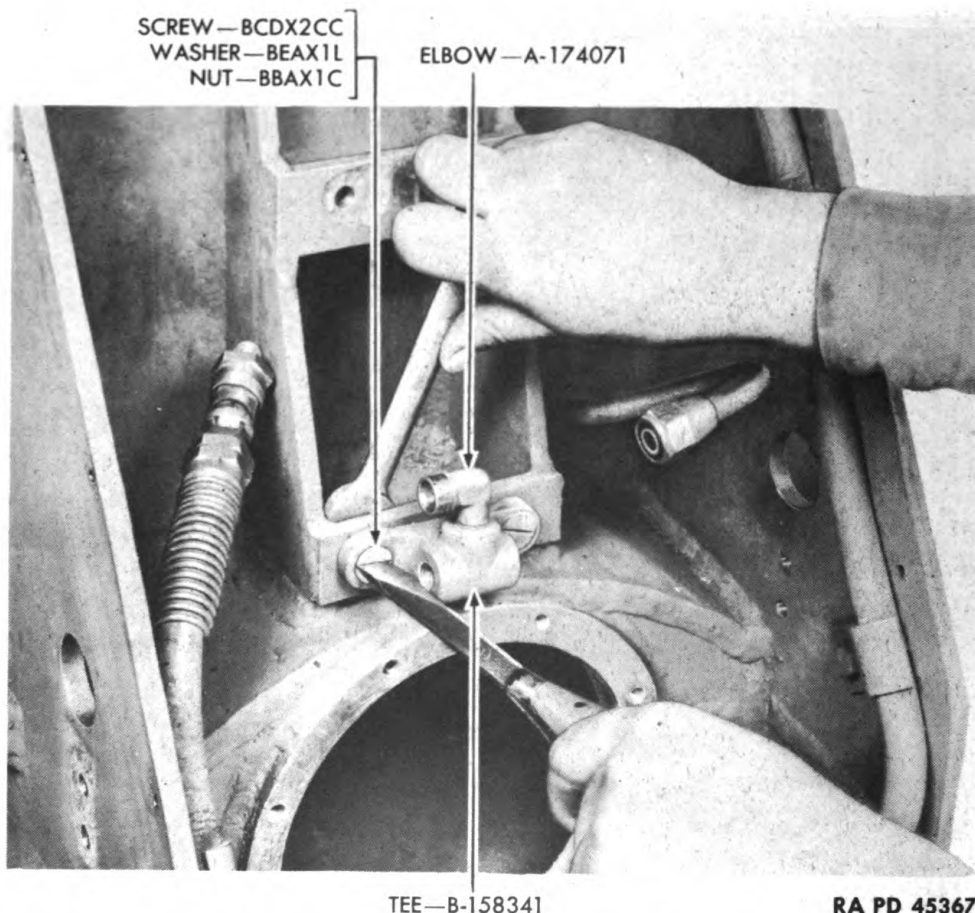


Figure 219—Removing Tee from Bottom Carriage

83. MAINTENANCE AND REPAIR OF BOTTOM CARRIAGE.

a. General.

(1) Clean all parts of the bottom carriage thoroughly with SOLVENT, dry-cleaning.

(2) Examine bottom carriage carefully for cracks or other damage. Slight damage, insufficient to cause serious damage to the materiel in future service, may be repaired by welding. If damage is serious, replace the bottom carriage with a new one.

(3) Replace all other badly worn or damaged parts with new parts.

b. Replace Worn Pintle Bushing.

(1) To replace a badly worn or scored pintle bushing, cut bushing B105024 out of bottom carriage with a chisel and hammer (fig. 222). **CAUTION:** Avoid damaging bottom carriage.

(2) Coat mating surfaces of new pintle bushing and bottom car-

BOTTOM CARRIAGE

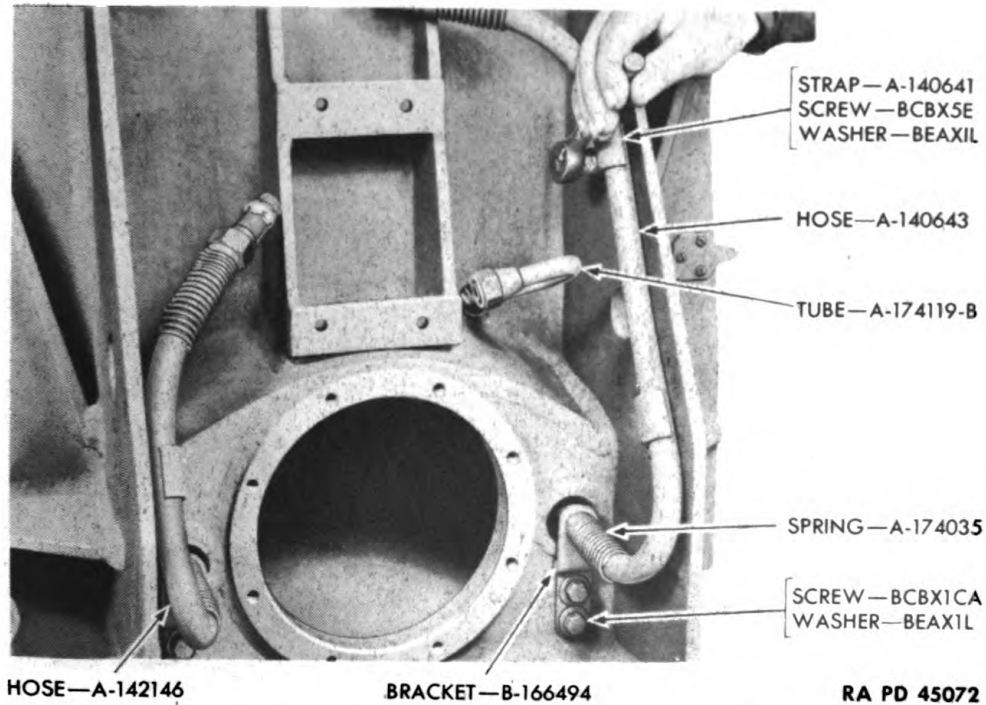


Figure 220—Removing Air Line Hose Strap

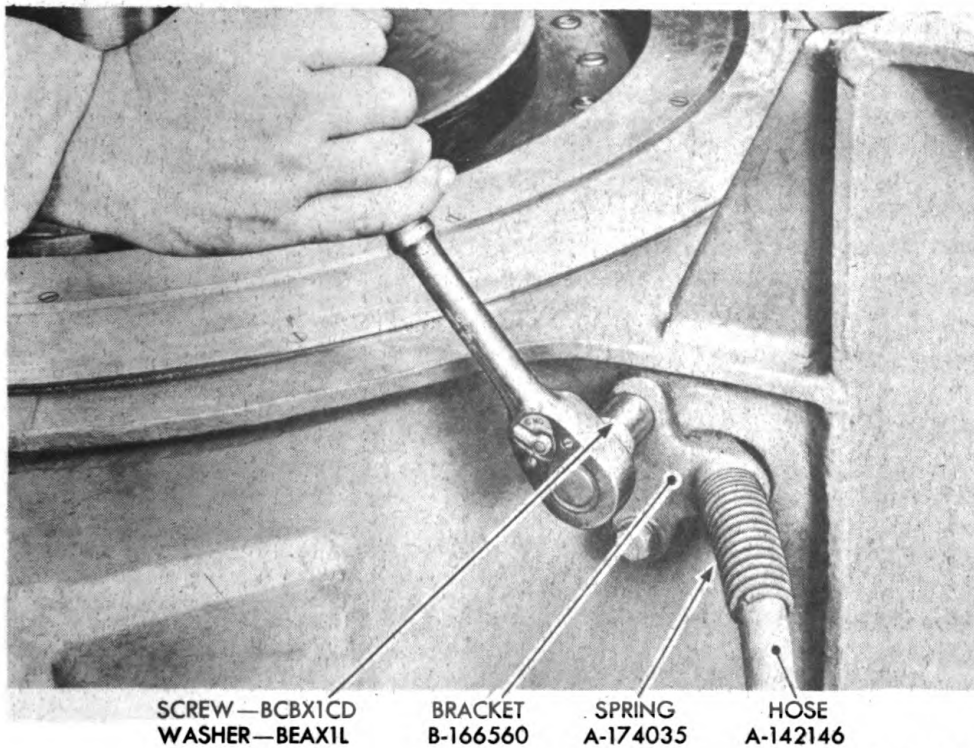


Figure 221—Removing Air Line Hose Support Rear Bracket

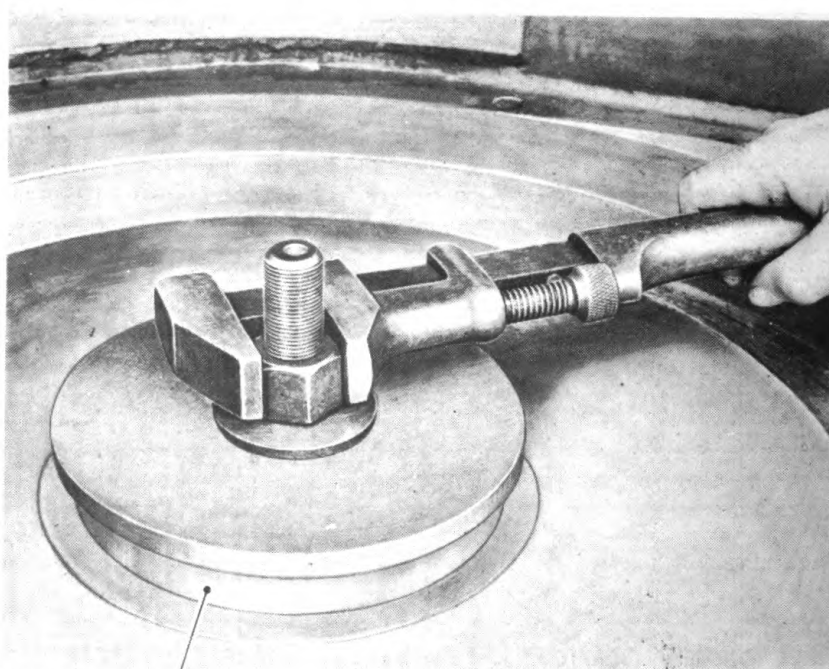
**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



BUSHING—B-105024

RA PD 44484

Figure 222—Removing Bushing from Bottom Carriage



BUSHING—B-105024

RA PD 45068

Figure 223—Installing Pintle Bushing

BOTTOM CARRIAGE

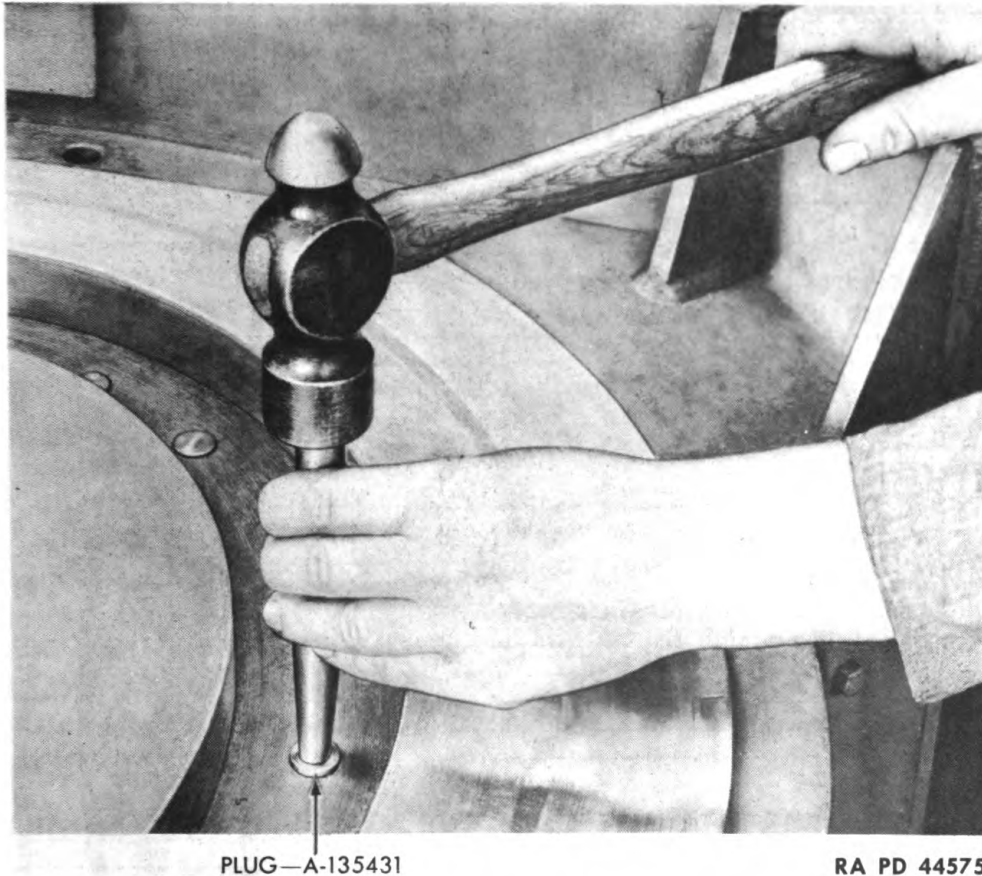


Figure 224—Installing Centering Plug

riage with **TALLOW**, mutton, refined, or **LEAD**, white. Line up new bushing with opening in bottom carriage. Install improvised pintle bushing inserting tool (figs. 24 and 223), and draw bushing all the way down into bottom carriage. When properly installed the end of the bushing will be flush with the top face of the bottom carriage.

c. Replace Loose or Damaged Centering Plugs.

(1) Twenty of these spring centering plugs A135431 are fitted tightly into bottom carriage (fig. 210). Examine all plugs for looseness or damage.

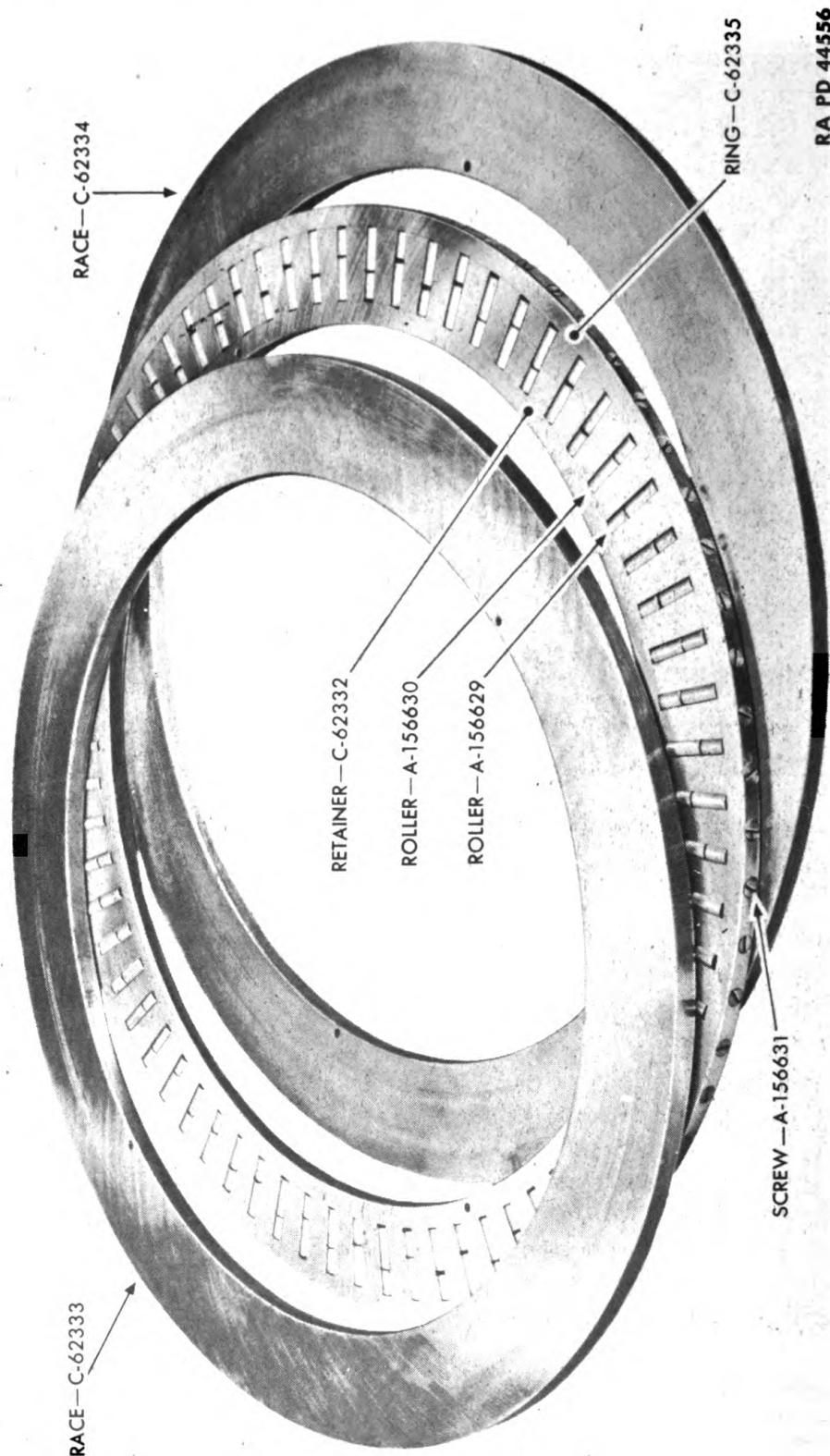
(2) Remove loose or damaged plugs with an Ezy-out extractor.

(3) Coat mating surface of new centering plug or plugs, and the opening or openings in bottom carriage with **TALLOW**, mutton, refined, or **LEAD**, white. Drive new plug or plugs in place with a brass drift and hammer (fig. 224).

d. Repair Top Carriage Supporting Roller Bearing.

(1) The top carriage supporting roller bearing consists of an upper race C62333, retainer assembly, and lower race C62334 (fig. 225).

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 44556

Figure 225—Top Carriage Supporting Roller Bearing

BOTTOM CARRIAGE

The retainer assembly consists of retainer C62332, ring C62335, 70 each of two different size rollers A156630 and A156629, and 70 screws A156631.

(2) Examine the two races for damage or scratches. Examine the retainer, ring, and rollers for damage or scratches. Replace worn or damaged rollers. Remove scratches by polishing with CLOTH, crocus, and clean with SOLVENT, dry-cleaning.

(3) To replace worn or damaged rollers, mark the ring C62335 and retainer C62332 with a fine assembly line, preferably with LEAD, white, so ring and retainer will be assembled in same position. Remove 70 screws A156631 from ring and retainer.

(4) Place the retainer assembly on eight $\frac{1}{2}$ - x $\frac{3}{4}$ - x $2\frac{1}{2}$ -inch wood blocks. NOTE: Do not place blocks under ring C62335. Remove ring by tapping lightly all around ring, not in one place (fig. 226).

(5) Slide damaged or worn roller or rollers out of retainer C62332 (fig. 227). Replace with new rollers.

(6) Line up assembling marks made on retainer and ring, and install ring. Insert four of the retaining screws after coating threads with COMPOUND, rust-preventive, light. These four screws should be inserted 90 degrees apart. Then insert the other 66 screws after coating threads with COMPOUND, rust-preventive, light.

(7) Remove assembling marks and lubricate entire bearing with OIL, engine (seasonal grade). Make sure to get oil all around rollers.

e. Repair Scored or Bruised Circular Liner. If the brass circular liner C7186 (fig. 206) is scored or bruised, remove scores or bruises with a flat scraper. Polish with CLOTH, crocus; clean with SOLVENT, dry-cleaning. Remove only enough metal to eliminate score or bruise.

f. Smooth Trail Hinge Pin Bearing Surfaces.

(1) Examine trail hinge pin bearing surfaces in each side of bottom carriage. Polish with CLOTH, crocus, when burred, rusted, or scored. Clean thoroughly with SOLVENT, dry-cleaning.

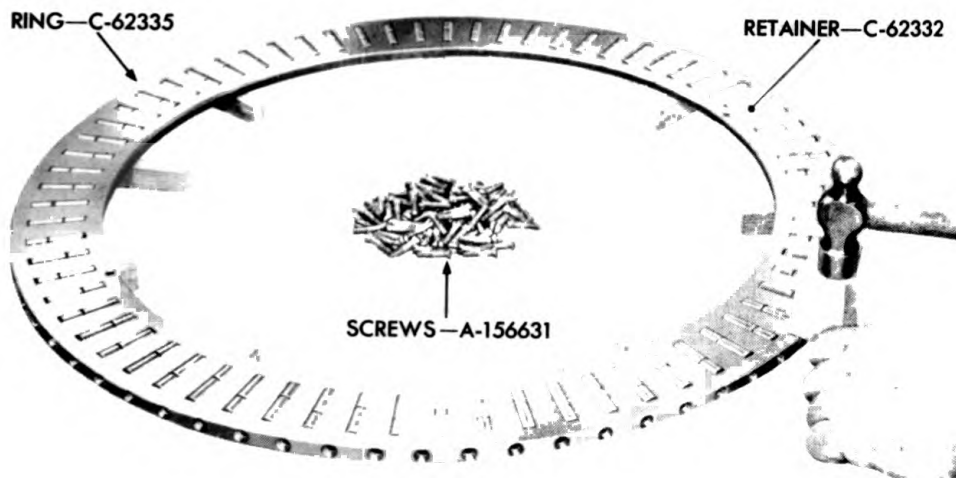
(2) Rust and scoring is an indication of lack of proper lubrication. Examine trail hinge pin for clogged lubrication channel and repair (par. 87 c).

NOTE: Disassembly, maintenance, repair, and assembly of the relay-emergency valve and air reservoir are covered in paragraphs 109, 110, and 111.

84. ASSEMBLE BOTTOM CARRIAGE.

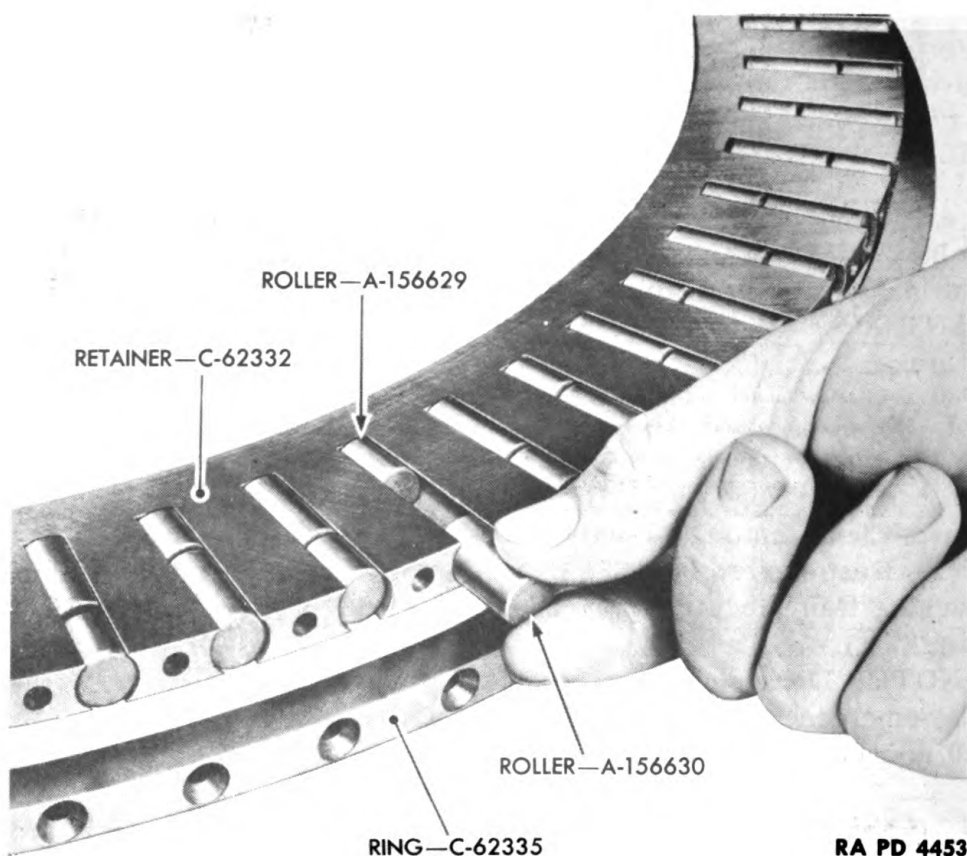
a. Replace Pipe Plug. Replace the square-head pipe plug in rear of bottom carriage. Make certain that the lubrication channel in bottom carriage is open and clean (fig. 207).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44535

Figure 226—Removing Roller Bearing Ring



RA PD 44536

Figure 227—Removing Roller from Roller Bearing

BOTTOM CARRIAGE

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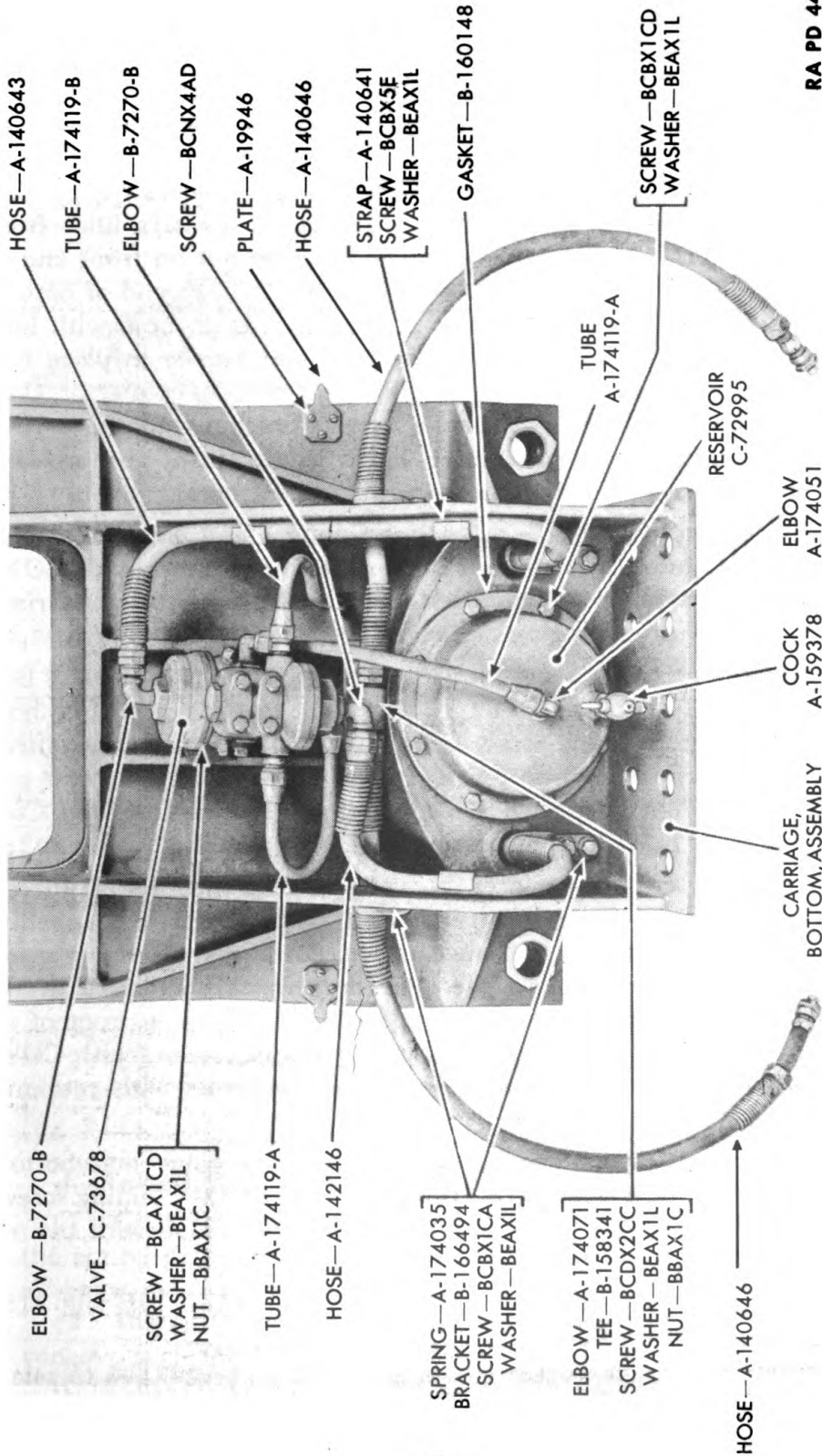


Figure 228—Carriage Air Lines, Relay-emergency Valve, and Air Reservoir Group

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

b. Install Relay-emergency Valve, Air Reservoir, Air Hoses, and Tubes (fig. 228).

(1) If air line hoses A142146 and A140643 have been removed (par. 82 d (11) and 12)), install as follows: Slide the air line hose with rear air line hose support bracket and spring assembled, through bottom carriage from rear (fig. 221). Coat bracket retaining screw threads with COMPOUND, rust-preventive, light. Secure the bracket to bottom carriage with two retaining screws and washers. Slide front hose support bracket, two springs, and connector nut on front end of air line hose after it is pushed through opening in front end of bottom carriage (fig. 220). Slide the brass connector ring on hose with long slots to front end of hose. Cement the hose end washer in place and insert end of connector in hose (fig. 229). Join parts of connector. Coat threads of hose strap and front hose support bracket retaining screws with COMPOUND, rust-preventive, light. Secure straps and brackets to bottom carriage with retaining screws and washers.

(2) Coat mating surfaces of air line front tee and bottom carriage with LEAD, white. Coat threads of tee retaining screws with COMPOUND, rust-preventive, light. Secure tee and elbow to top carriage with two retaining screws, washers and nuts (fig. 219).

(3) Insert air line hoses A140646 through openings in sides of bottom carriage. (NOTE in par. 82 d (9).) Coat threads of air line hose support bracket retaining screws with COMPOUND, rust-preventive, light. Secure brackets to bottom carriage with retaining screws and washers (fig. 218). Connect hose connectors at air line front tee. Connect tube A174119A to compression tube elbow on air line front tee.

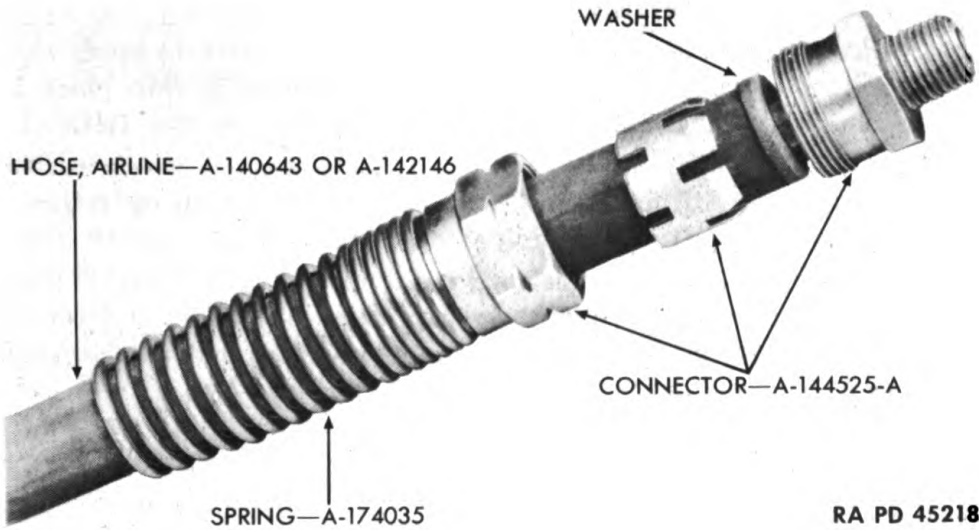
(4) Shellac mating surfaces of vellumoid gasket B160148, air reservoir C72995, and bottom carriage with VARNISH, shellac, orange. Install gasket on bottom carriage. Carefully insert air reservoir in place in bottom carriage. The drain cock should be at the bottom. Be sure tube A174119A is installed on elbow in front of air reservoir. Coat threads of eight reservoir retaining screws with COMPOUND, rust-preventive, light. Secure air reservoir with retaining screws and washers (fig. 217).

(5) Coat mating surfaces of relay-emergency valve and bottom carriage with LEAD, white. Coat threads of two valve retaining screws with COMPOUND, rust-preventive, light. Install valve with two retaining screws, nuts, and washers (fig. 216).

(6) Attach two tubes A174119A and one tube A174119B (fig. 215) to relay-emergency valve.

(7) Connect brake air line hoses A140643 and A142146 to relay-emergency valve. Hose A140643 is connected to allow elbow in top of valve and hose A142146 to elbow in bottom of valve (fig. 215).

BOTTOM CARRIAGE



RA PD 45218

Figure 229—Air Line Hose, Spring, and Connector

(8) Check all tube and hose connections for correct installation and tightness (fig. 228).

(9) Coat threads of nine relay-emergency valve cover retaining screws with **COMPOUND**, rust-preventive, light. Install relay-emergency valve cover with screws and washers (fig. 214).

(10) Coat threads of air line tee retaining screws with **COMPOUND**, rust-preventive, light. Secure tee to top of bottom carriage with two screws **BCDX2CA** and washers **BEAX4G** (fig. 213).

(11) Connect tube **A174119B** to air line tee (fig. 213).

(12) Mount two hoses **A140646** by connecting hose connectors **A144525A** to air line tee (fig. 212) (**NOTE**, par. 82 d (1)).

c. Install Bottom Carriage Circular Liner.

(1) Install brass circular liner on top of bottom carriage.

(2) Coat threads of 24 retaining screws with **COMPOUND**, rust-preventive. Secure circular liner to bottom carriage with these screws (fig. 211).

d. Install Belleville Springs.

(1) Coat with grease the entire surface of bottom carriage where the spring centering plugs are installed. Grease springs all over with a heavy coat of **GREASE**, general purpose (seasonal grade).

(2) Install the Belleville springs on the centering plugs with the concave surface of springs up. Pack grease in between and on springs. **CAUTION:** It is very important that two types of Belleville spring (**B158580** and **B158581**) be installed in their proper relative positions (**CAUTION**, par. 82 b (1)).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

e. Install Top Carriage Supporting Roller Bearing (fig. 225).

(1) Screw the two improvised lifting hooks in place in lower race of supporting roller bearing. Lower the race carefully into place in bottom carriage. **CAUTION:** Do not knock any of the Belleville springs off centering plugs.

(2) Screw the lifting hooks into place in the bearing retainer assembly and lower it into place on top of lower race.

(3) Screw the lifting hooks into place in the upper race of supporting bearing and carefully lower upper race in place on top of retainer assembly. **NOTE:** The bearing was lubricated as described in paragraph 83 d (7).

f. The traversing arc was mounted as part of the traversing mechanism (par. 67 c).

Section XIX

TRAILS, TRAIL HINGE PINS, AND SPADES

	Paragraph
General	85
Disassemble trails	86
Maintenance of trails, trail hinge pins, and spades	87
Assemble trails	88

85. GENERAL.

a. The right and left trails are heavy, tapered, box-construction welded steel members attached to the bottom carriage by means of trail hinge pins. These trail hinge pins permit trails to be pivoted in order to place the trails in firing or traveling position. The trail hinge pins are held in place by threaded plugs that screw into the bottom of the hinge pins.

b. Brackets for carrying the spades and accessories in traveling position are attached to the trails. The front spades are assembled in front spade brackets on the bottom carriage when in firing position. Trail spades are attached in slots at ends of trails and secured to trails by keys.

c. Trail air lines and connections are assembled to the inside surface of each trail. They connect the air brake diaphragms, air reservoir, and relay-emergency valve with air lines on the Heavy Carriage Limber M2. The prime mover provides the air for operation of air brakes when the carriage is traveling (figs. 230, 231, 232, and 233).

NOTE: Parts marked with a single asterisk on the illustrations are welded components, and are not listed in SNL D-24 or SNL D-29.

86. DISASSEMBLE TRAILS.

a. Disassemble Left Trail.

(1) Disconnect hose connectors A144525A, remove two screws BCAX1CB and washers BEAX1L, and lift air filter C85464 away (fig. 234). Then disconnect hose from bracket B166469.

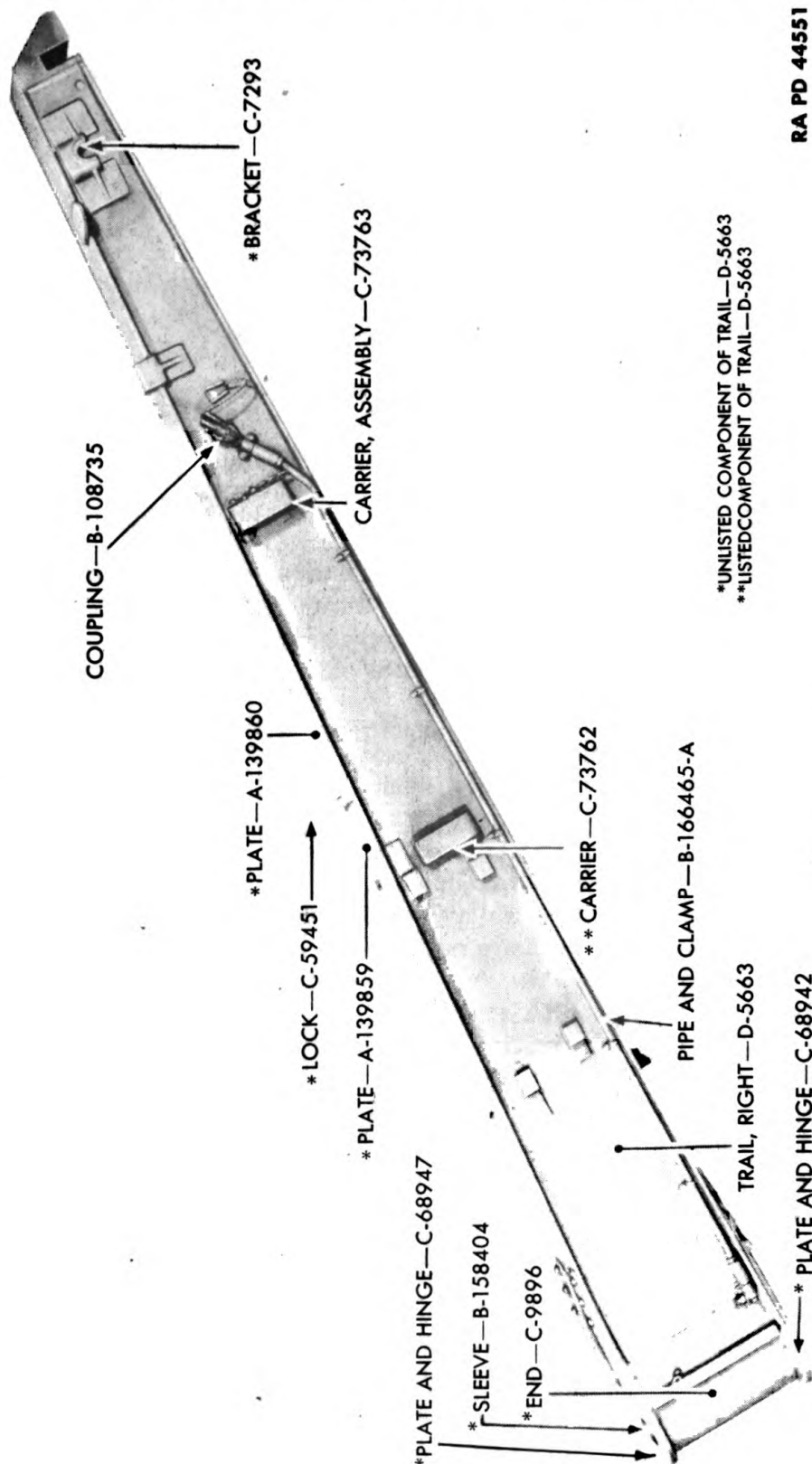
(2) Remove two screws BCBX1CA and washers BEAX1L from bracket B166469 (fig. 235).

(3) Remove screws BCBX5B and washers BEAX1H from five clamps A161750 and remove clamps (fig. 236).

(4) Remove the two screws BCBX1CA and washers BEAX1L from bracket B166432 (fig. 237). Remove bracket B166432, coupling B108582, and pipe and clamp assembly B166434, as a unit.

b. Disassemble Right Trail. Proceed as described in subparagraph a (1), (2), (3), and (4) above, to disassemble right trail.

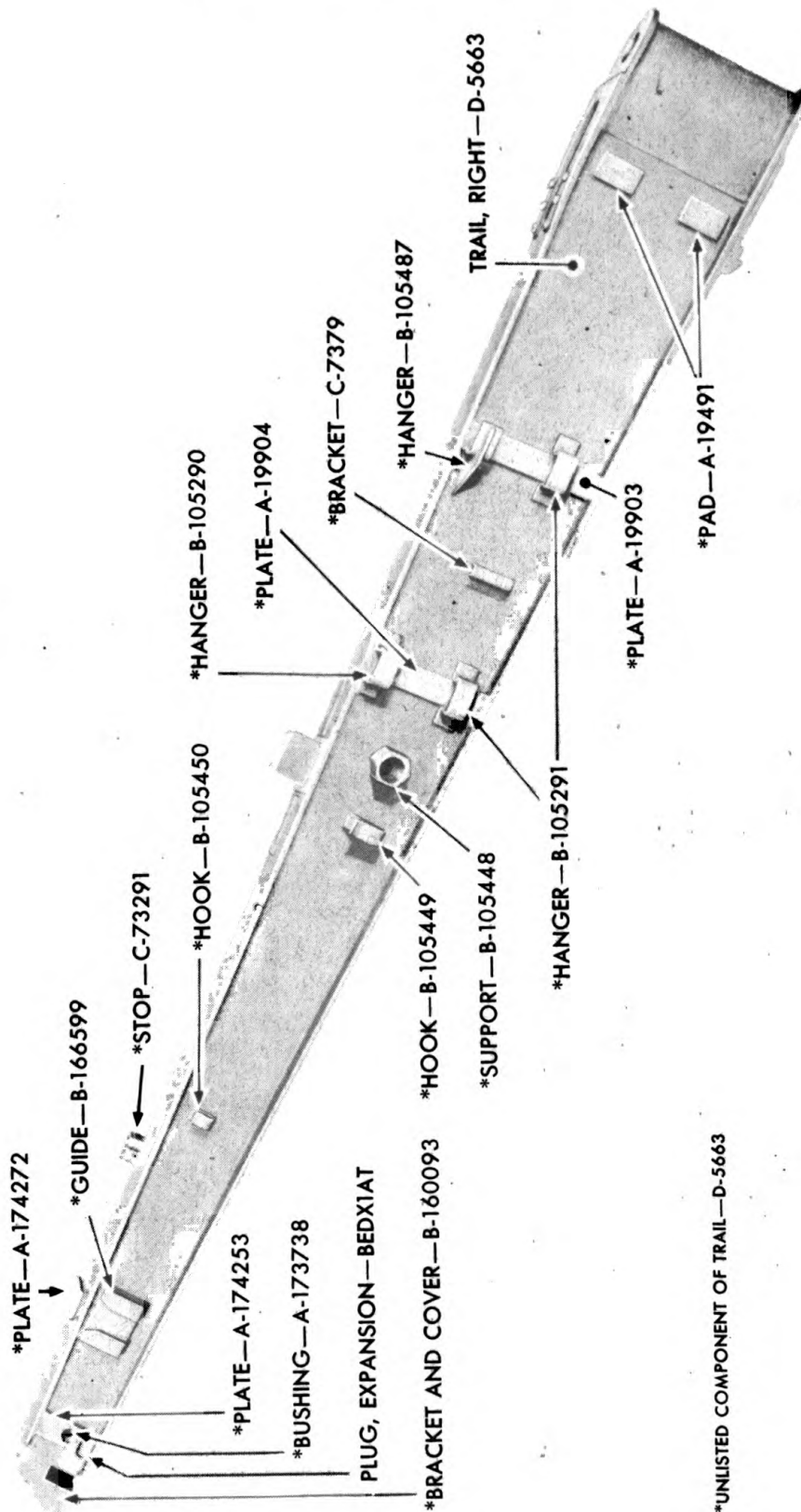
ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 44551

Figure 230—Right Trail—Inside

TRAILS, TRAIL HINGE PINS, AND SPADES



RA PD 44552

Figure 231—Right Trail—Outside

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

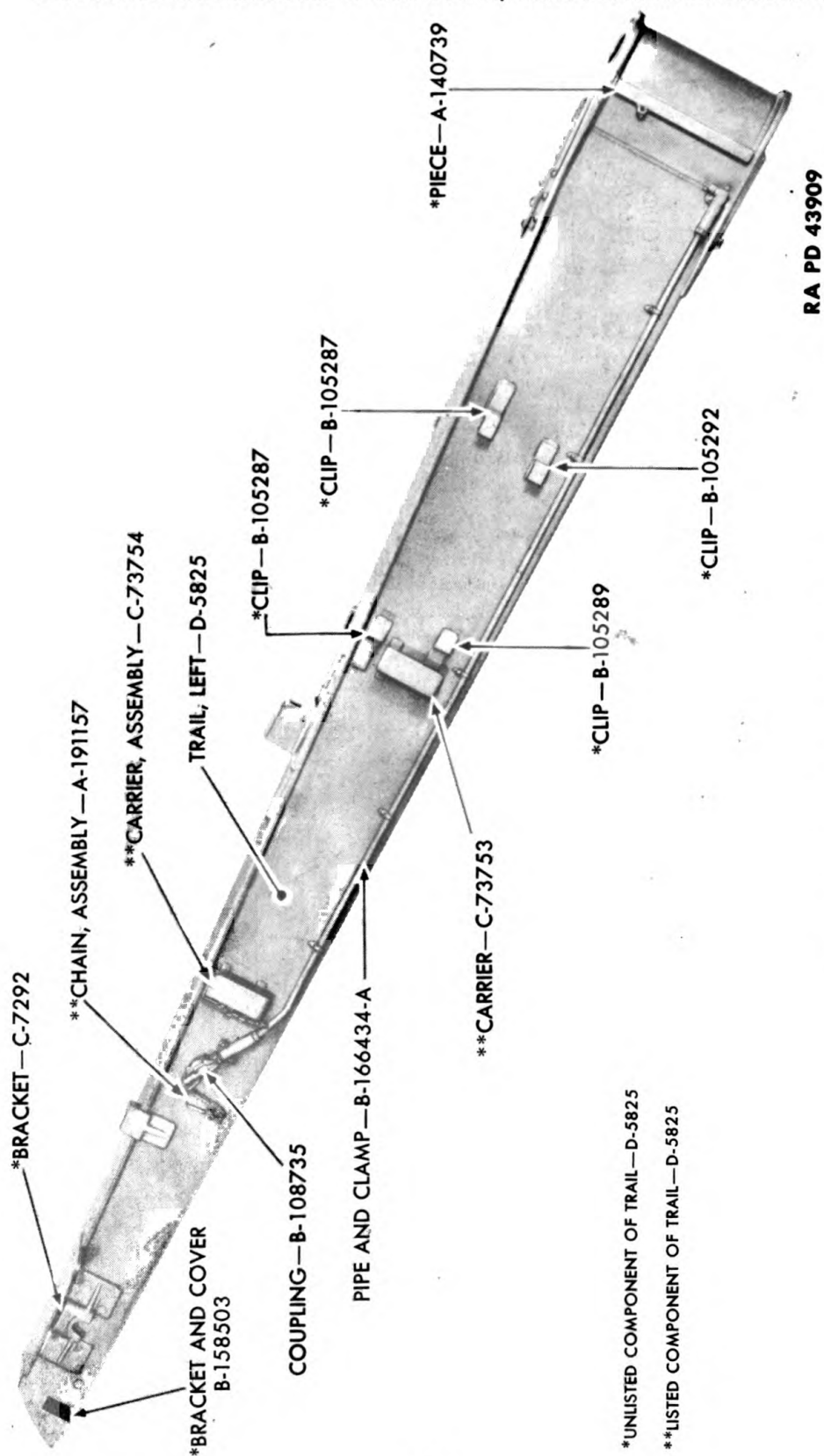


Figure 232—Left Trail—Inside

RA PD 44550



Figure 233—Left Trail—Outside

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

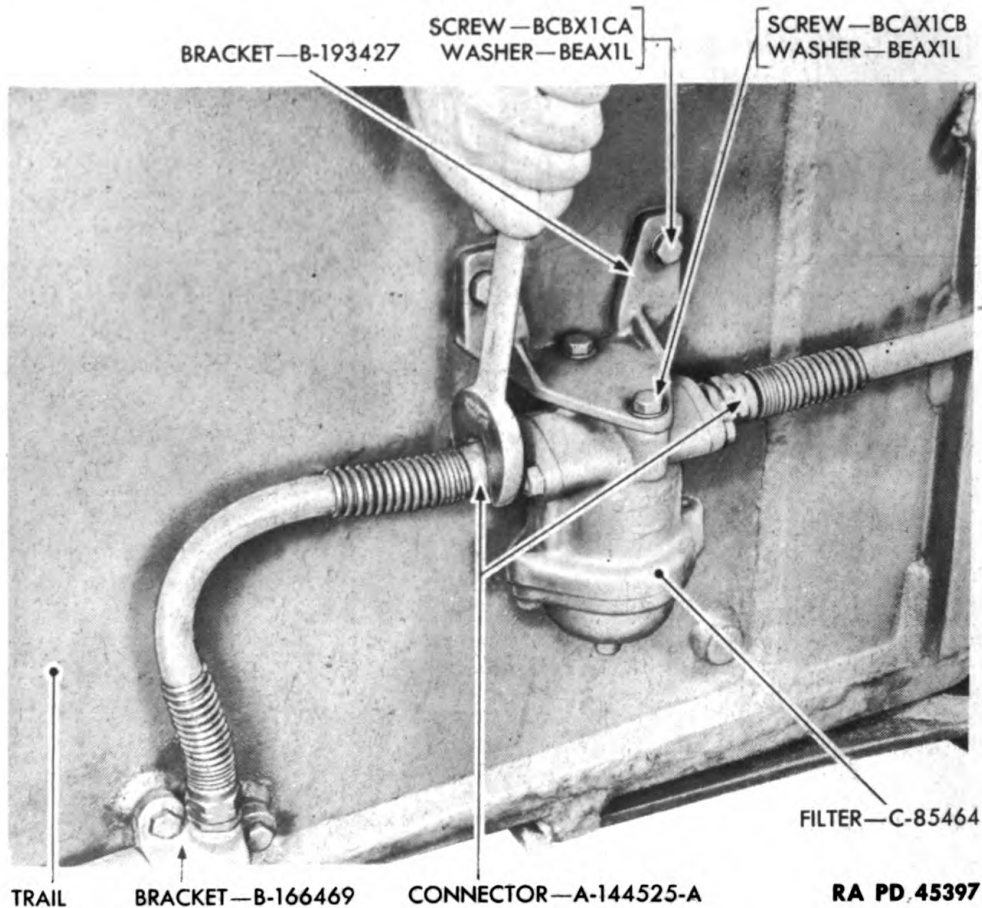


Figure 234—Removing Air Filter

87. MAINTENANCE OF TRAILS, TRAIL HINGE PINS, AND SPADES.

a. General.

(1) Clean trails, trail hinge pins, spades, and all metal parts of trail air lines with SOLVENT, dry-cleaning.

(2) Examine trails closely for cracks and broken welds. Slight damage, insufficient to cause trouble, or added damage in future service, may be repaired by welding. If damage is serious, replace the trail with a new one. For proper fitting of a new trail, see paragraph 114.

(3) Examine all four spades for damage. If not seriously damaged, repair as outlined above. Replace a badly damaged spade with a new one.

b. Replace Spade Support.

(1) If a front spade support (fig. 238) is damaged, but the spade can be made serviceable by replacing the support, proceed as follows:

TRAILS, TRAIL HINGE PINS, AND SPADES

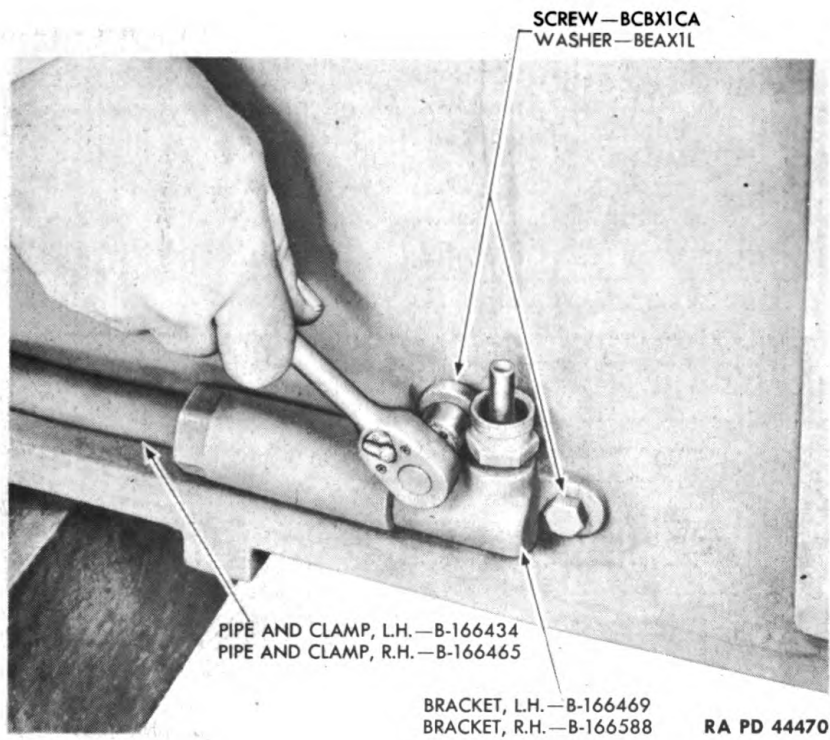


Figure 235—Removing Front Bracket from Trail

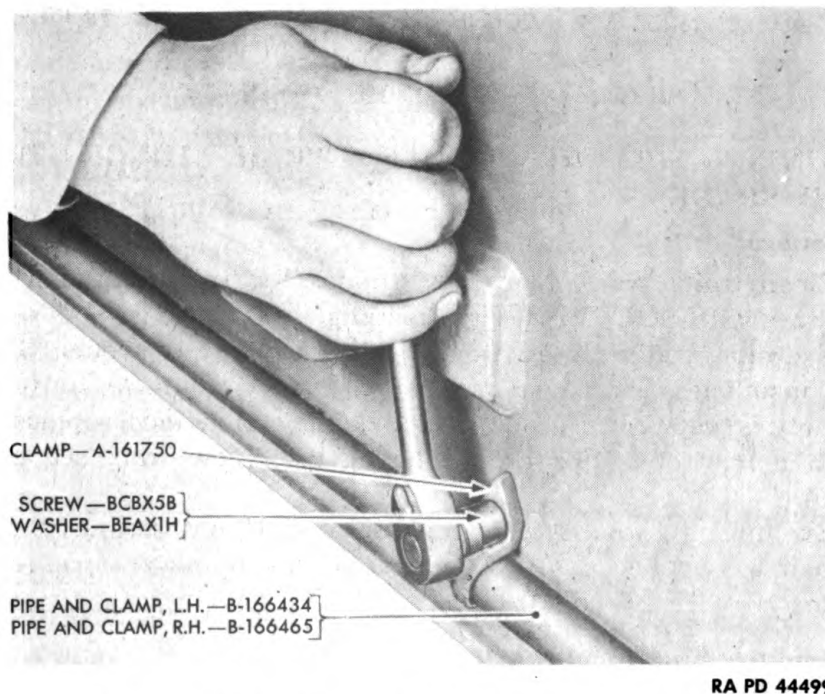


Figure 236—Removing Clamp from Trail

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

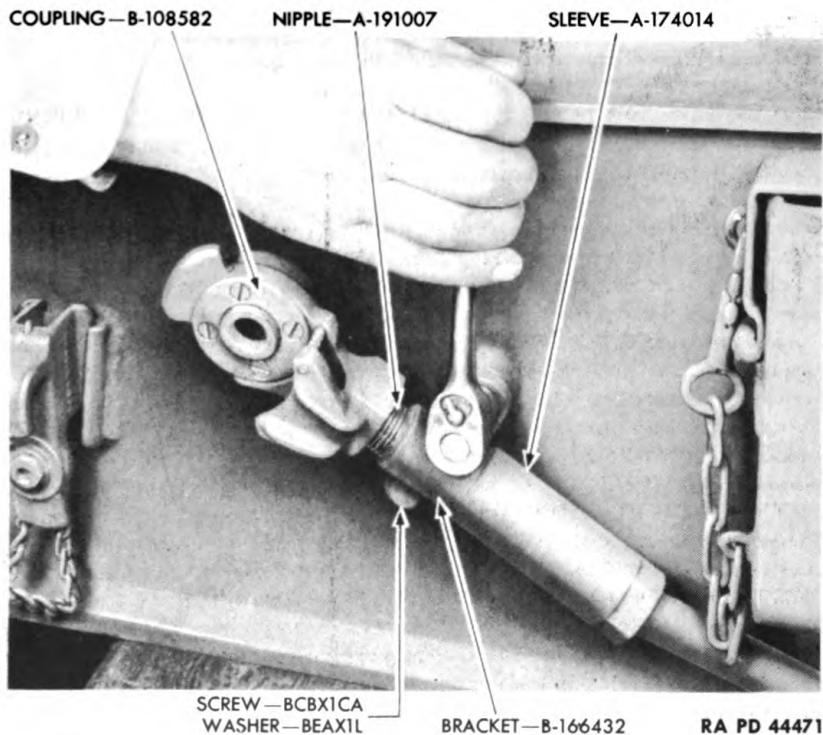


Figure 237—Removing Rear Bracket from Trail

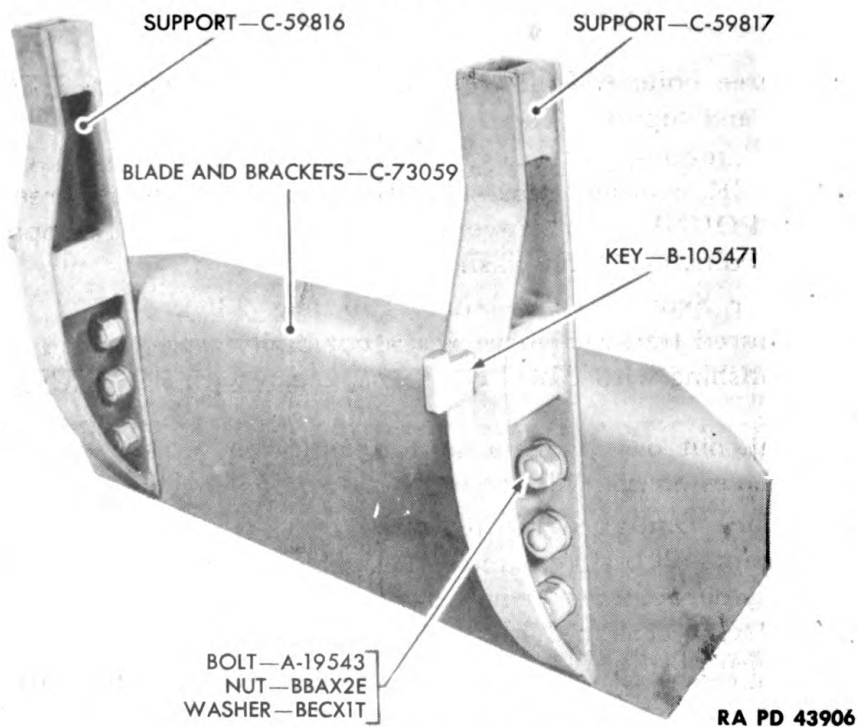


Figure 238—Right Front Spade Assembly

TRAILS, TRAIL HINGE PINS, AND SPADES

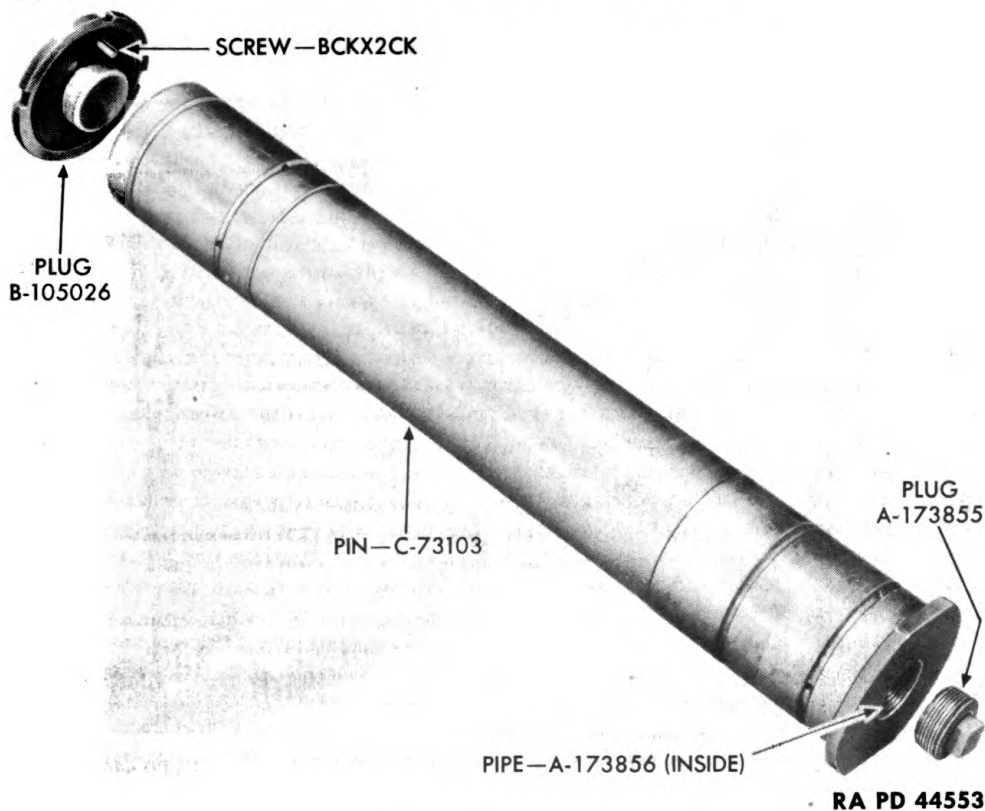


Figure 239—Trail Hinge Pin

Remove three bolts A19543, nuts BBAX2E, and washers BECX1T from spade and support. Tap out bolts.

(2) Paint mating surfaces of new spade support and front spade with **PRIMER**, synthetic, rust-inhibiting. Coat threads of three bolts with **COMPOUND**, rust-preventive, light, and secure support to spade with bolts, nuts, and washers.

c. Repair Scored Trail Hinge Pin (fig. 239).

(1) A scored trail hinge pin, when not badly scored, can be refinished by polishing with **CLOTH**, crocus. Clean with **SOLVENT**, dry-cleaning.

(2) Clean out oil channels in trail hinge pin so oil can flow to bearing surfaces on trail hinge pin, trails, and bottom carriage.

d. Replace Damaged Fittings.

(1) Examine all brackets and fittings attached to each trail. When badly damaged, replace with new parts.

(2) Replace a broken dummy coupling chain or rammer staff carrier chain with new parts (fig. 240). Straighten a bent rammer staff carrier.

e. For disassembly, maintenance, repair, and assembly of trail air lines and air filters, see paragraphs 109, 110, and 111.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

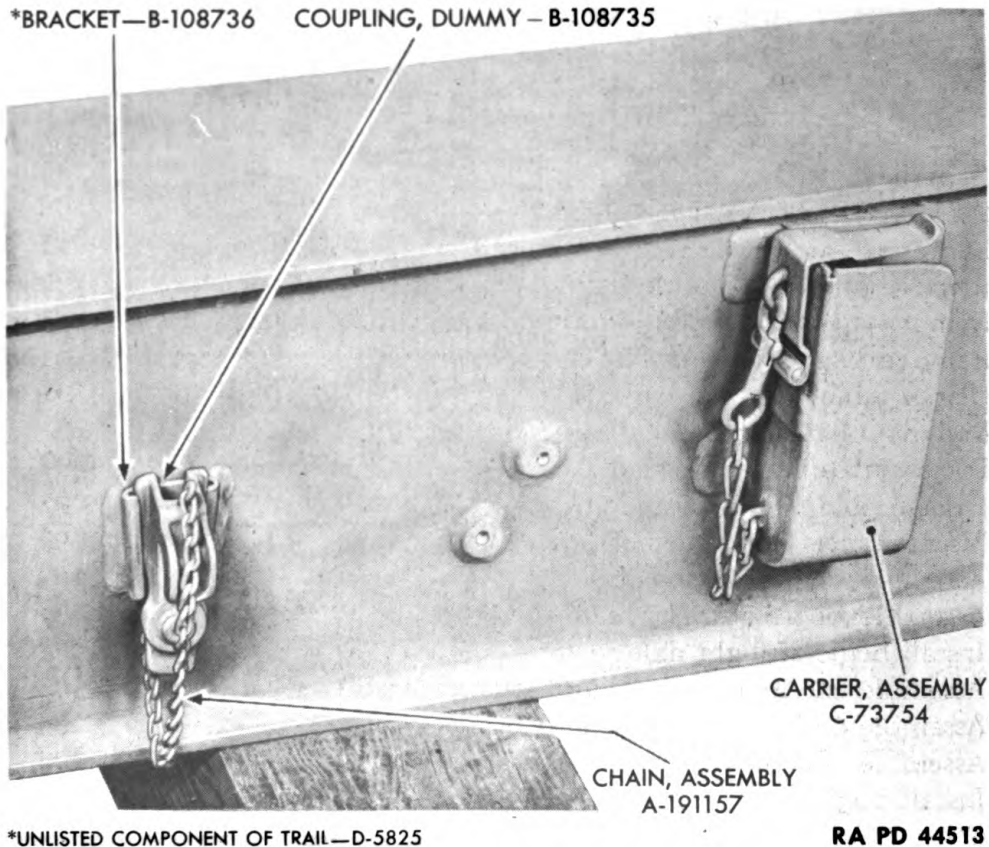


Figure 240—Dummy Hose Coupling and Rammer Staff Carrier

88. ASSEMBLE TRAILS.

a. Coat five conduit clamp retaining screws with **COMPOUND**, rust-preventive, light. Install pipe and clamp assembly B166434 against side of left trail. Secure with five conduit clamps, screws, and washers.

b. Coat threads of two air line rear bracket screws with **COMPOUND**, rust-preventive, light. Secure bracket to trail with two screws and washers (fig. 237). Air line coupling should be attached. If not, install it in the bracket.

c. Coat threads of two air line front bracket screws with **COMPOUND**, rust-preventive, light. Secure front bracket to trail with two screws and washers (fig. 235).

d. Coat threads of two air filter retaining screws with **COMPOUND**, rust-preventive, light. Secure air filter to air filter bracket with two screws and washers (fig. 234). Connect hose to front bracket B166469 and air filter. **NOTE:** The air line hose from filter to bottom carriage is not connected until trail is installed in bottom carriage, paragraph 114.

e. Proceed as described in subparagraphs a, b, c, and d above, to assemble right trail.

Section XX

BOGIE

	Paragraph
General	89
Disconnect wheel supporting cables	90
Remove bogie lifting screw assembly	91
Remove and disassemble cradle lock assembly	92
Remove and disassemble pintle and latch assembly	93
Remove bogie straight axle assembly	94
Disassemble bogie straight axle	95
Remove bogie arch axle	96
Disassemble bogie arch axle	97
Disassemble bogie crossbeam	98
Maintenance and repair of bogie	99
Assemble bogie crossbeam	100
Assemble bogie straight axle	101
Install bogie straight axle	102
Assemble and mount pintle and latch assembly	103
Assemble and install bogie arch axle	104
Assemble and install cradle lock assembly	105
Install bogie lifting screws	106

89. GENERAL.

a. Complete information on the function, operation, care and preservation of the bogie is contained in paragraphs 21, 22, 31, and 37, TM 9-335 and paragraphs 19, 25, and 27, TM 9-350.

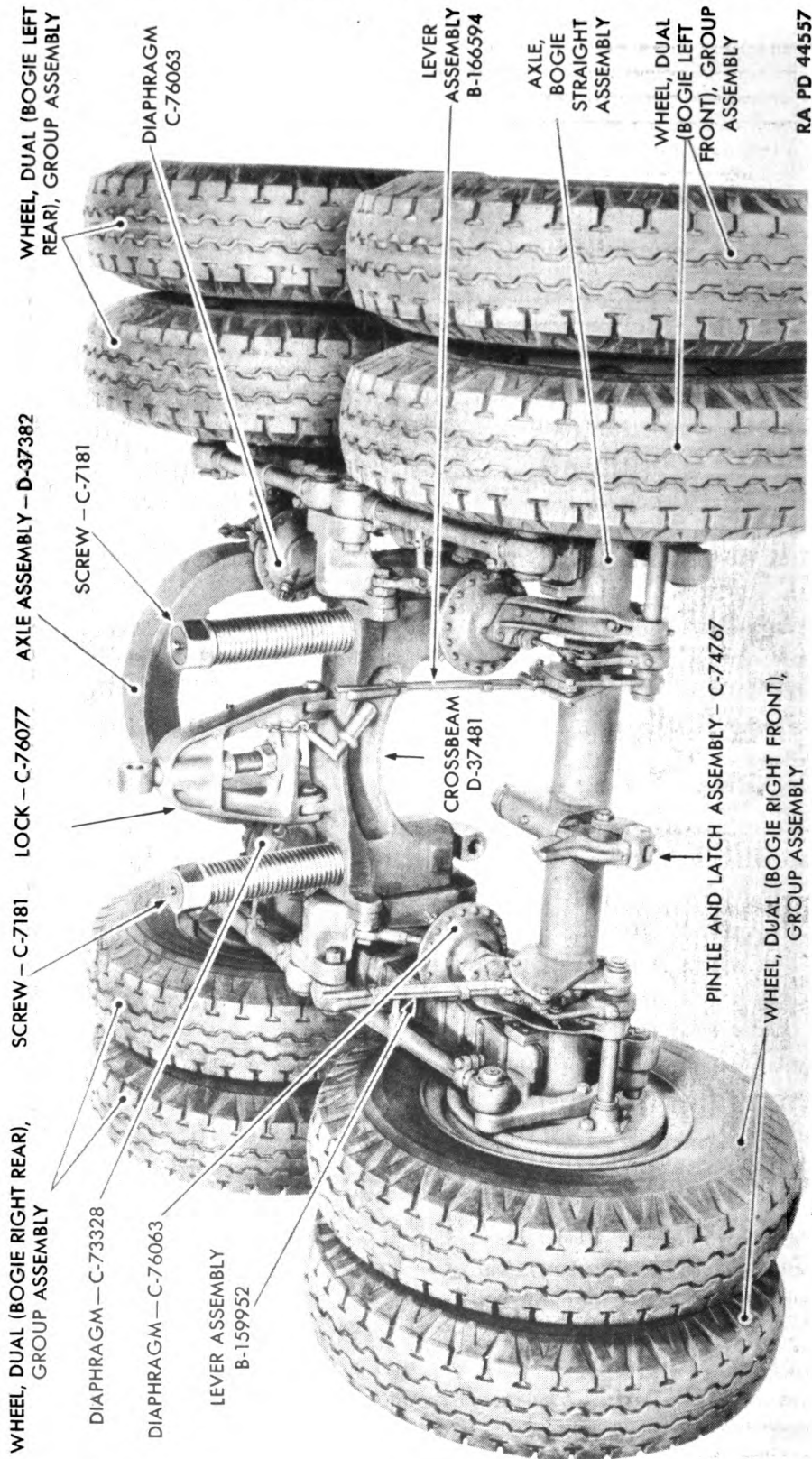
b. Malfunctions of the bogie proper (exclusive of the brake mechanism) are more likely to be caused by damage rather than general usage. Hence malfunctions are difficult to anticipate. Malfunctions of the brake mechanism and corrective measures for overcoming the malfunction are covered in paragraph 108.

c. Procedure for removal of bogie assembly from bottom carriage is described in paragraph 31. Installation of bogie is covered in paragraph 115.

90. DISCONNECT WHEEL SUPPORTING CABLES.

NOTE: When the bogie assembly was removed from the carriage (par. 31), the four wheel supporting cables were placed on the crossbeam torque bracket bolts. They were placed there to remove the weight of wheels and axles from bogie springs while the bogie was being removed. Their primary purpose is to remove the weight of wheels and axles from bogie springs when the materiel is in the firing position. These four cables cannot be tightened or loosened while on the bogie

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44557

Figure 241—Bogie Assembly

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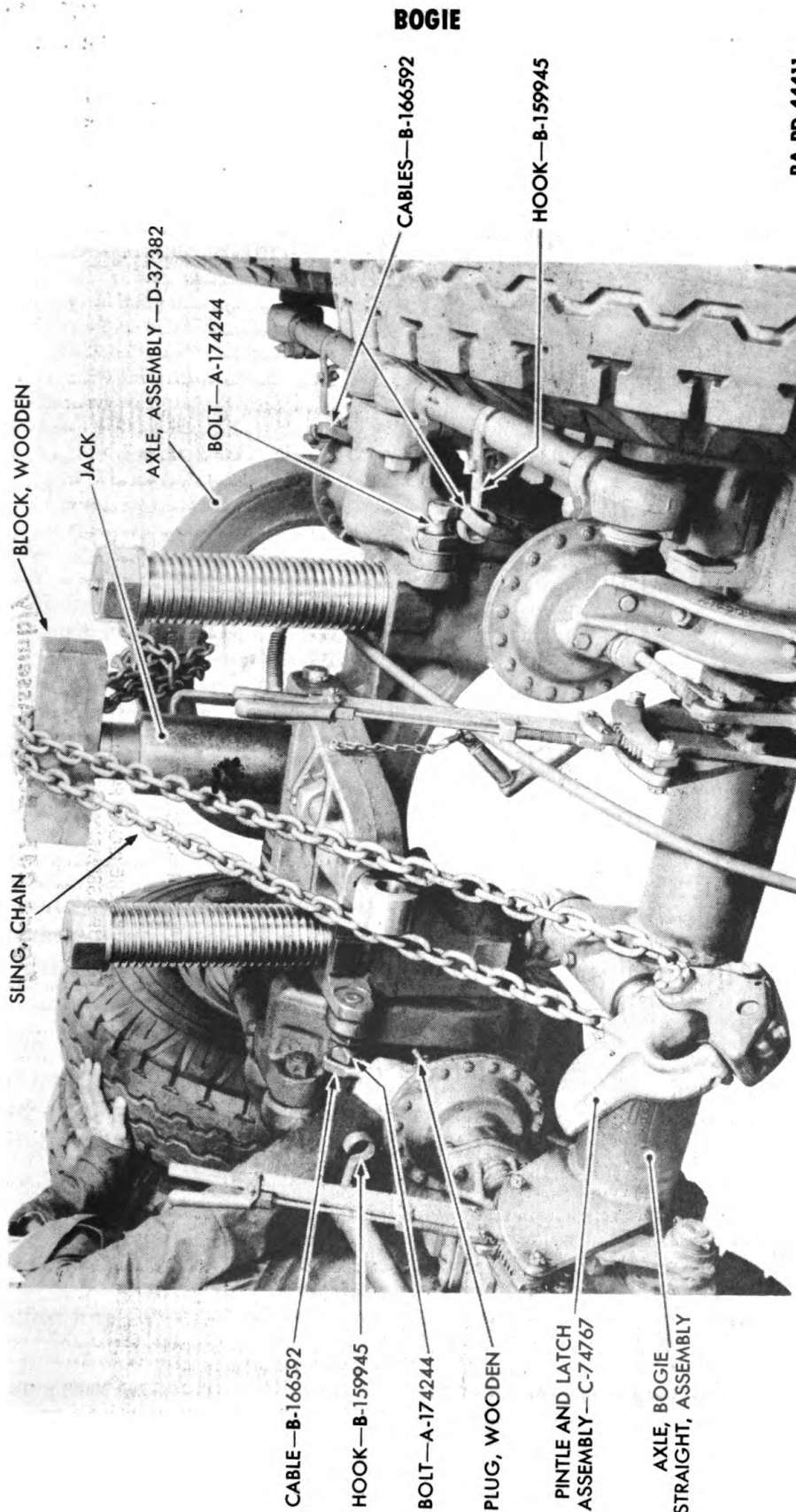


Figure 242—Removing Wheel Supporting Cable—Bogie Off Carriage

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

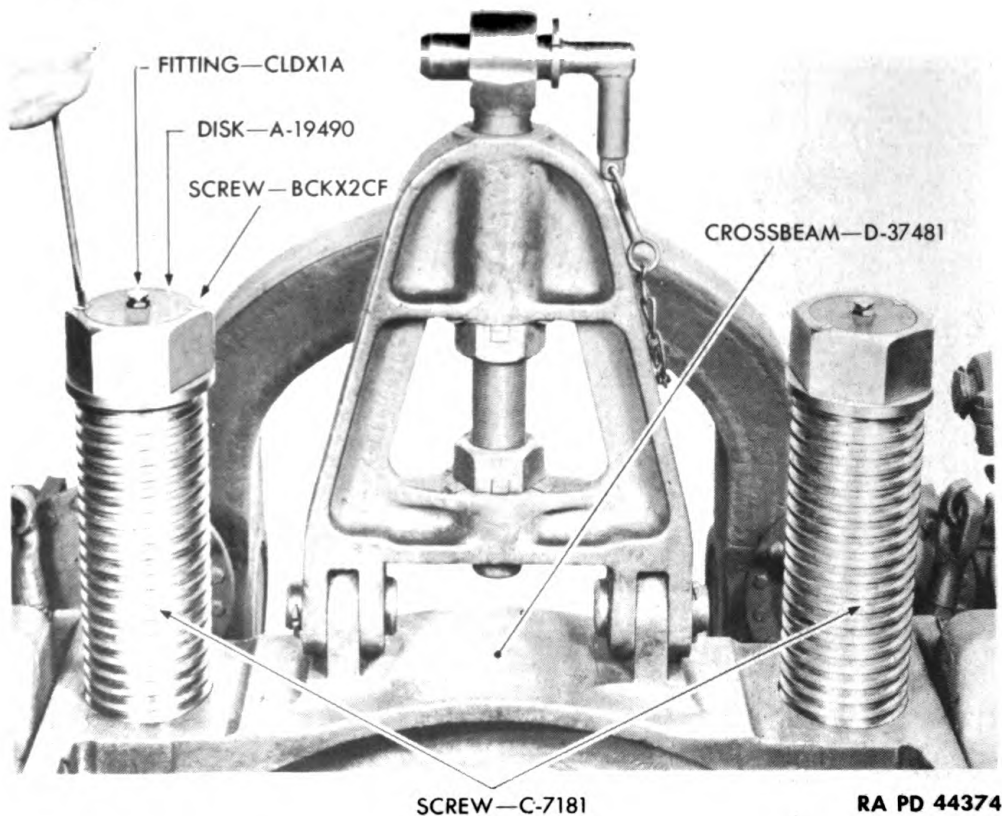


Figure 243—Removing Bogie Lifting Screw Disk

a. Place a chain or cable sling around bogie arch axle assembly D37382, and around pintle and latch assembly C74767 on straight axle (fig. 242).

b. Insert a jack and large wood block on bogie crossbeam under chain sling. Jack up block and sling, and depress bogie springs so that the four wheel supporting cables B166592 can be removed from bolts A174244 and placed on hooks B159945 (fig. 242). Place all four cables on their respective hooks.

91. REMOVE BOGIE LIFTING SCREW ASSEMBLY.

a. Remove Bogie Lifting Screw Disk.

(1) Remove two screws BCKX2CF from disk A19490 and remove disk (fig. 243).

(2) Turn bogie lifting outer screw C7181 clockwise until outer screw threads are about 4 inches below crossbeam D37481. Do not prevent inner screw C7183 from turning.

(3) Place a round brass bar (1-in. diam x 24 in.) through lower

BOGIE

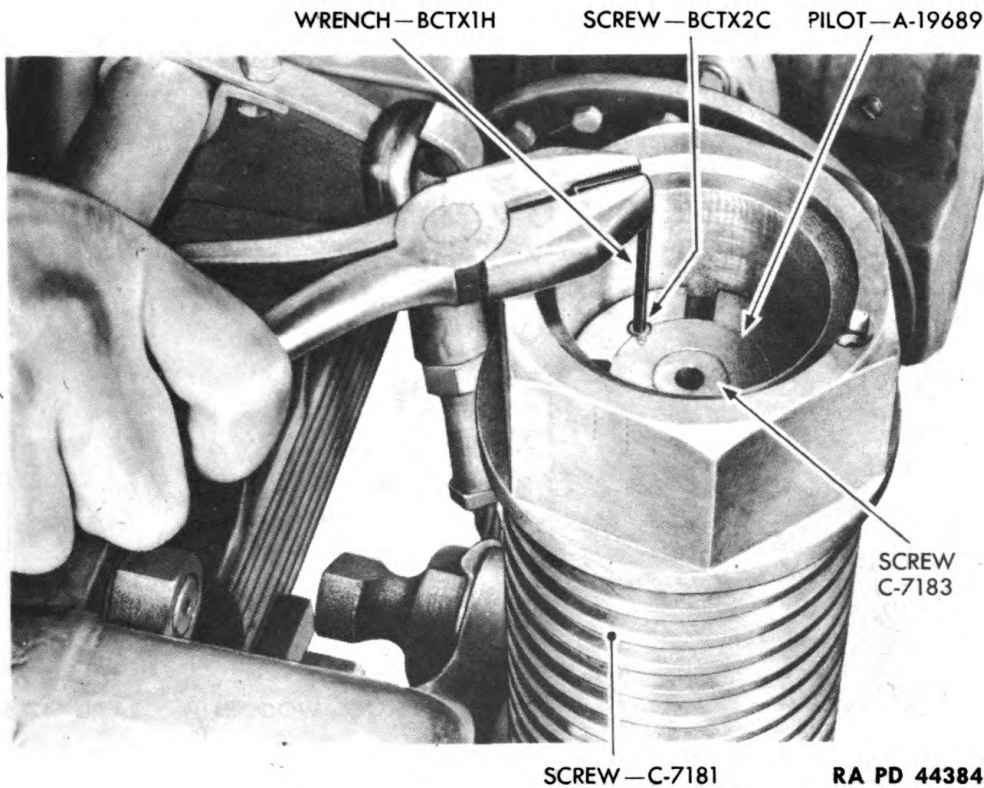


Figure 244—Removing Set Screw

end of bogie lifting inner screw. Have one end of brass bar rest against tire.

(4) Now turn outer screw counterclockwise, until bogie lifting inner screw is up as far as it will go. **NOTE:** Flat surface at lower end of inner screw threads will be up against bottom of outer screw.

(5) Remove the brass bar and the bogie lifting screw wrench.

b. Remove Bogie Lifting Screw Pilot.

(1) Remove screw BCTX2C from pilot A19689 (fig. 244).

(2) Using bogie lifting screw pilot wrench B105445 and a steel bar, unscrew and remove pilot from inner screw C7183.

c. Remove Bogie Lifting Inner and Outer Screws.

(1) Raise front end of bogie up and block it so it cannot tip or fall (fig. 245).

(2) Place bogie lifting screw wrench on outer screw to prevent it from turning. Then unscrew and remove inner screw C7183 by turning it with a round brass bar (fig. 245).

(3) Unscrew and remove outer screw C7181.

d. Repeat procedure as described in subparagraphs a, b, and c

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

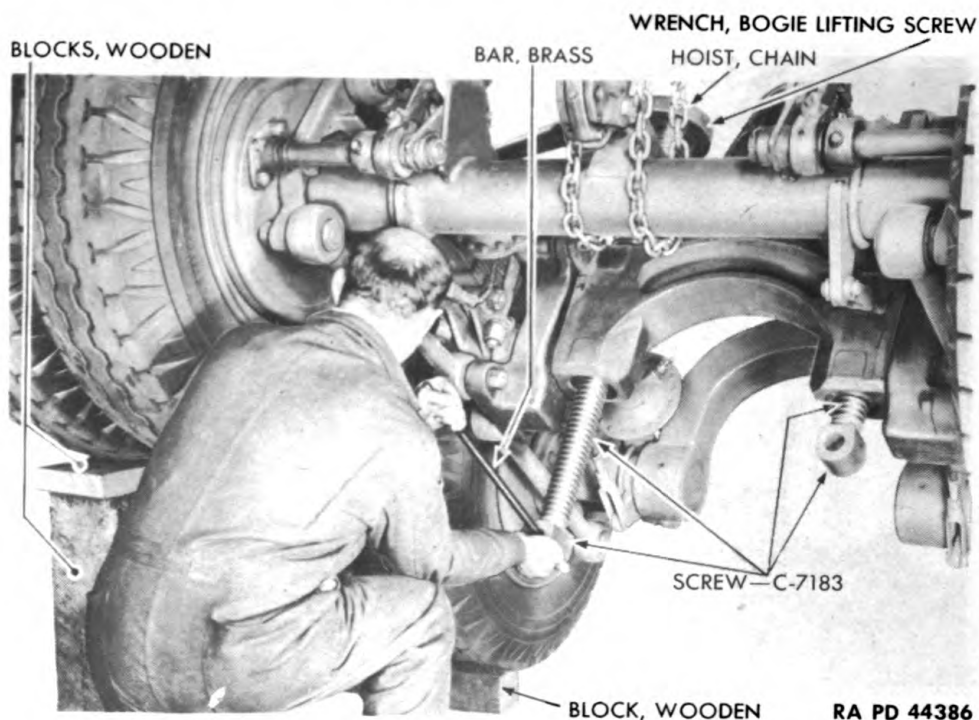


Figure 245—Removing Bogie Lifting Inner Screw

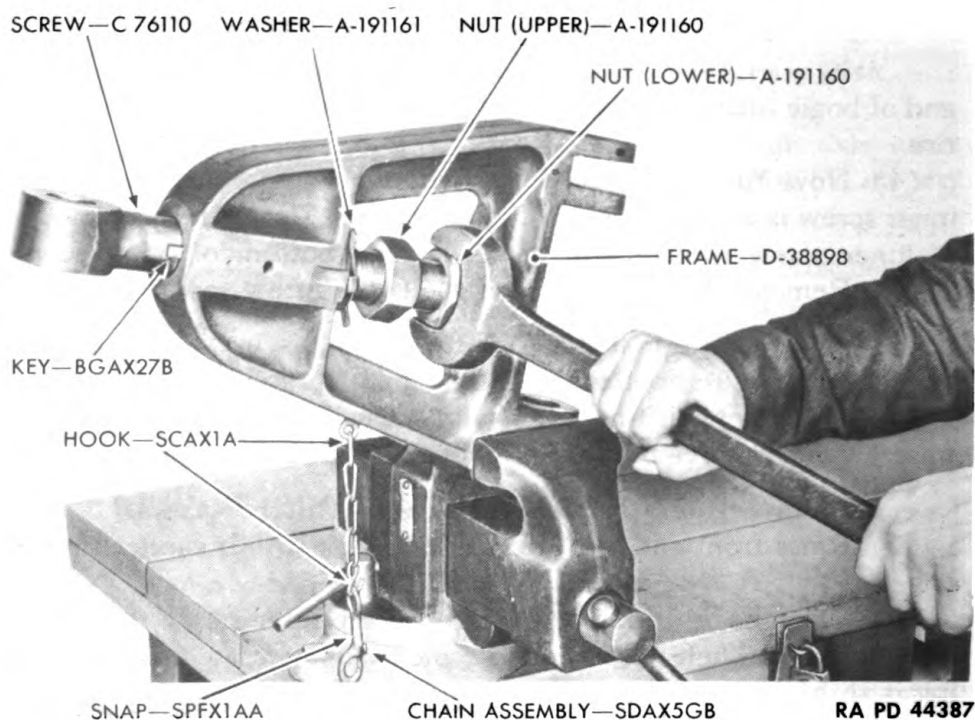


Figure 246—Removing Cradle Lock Screw

BOGIE

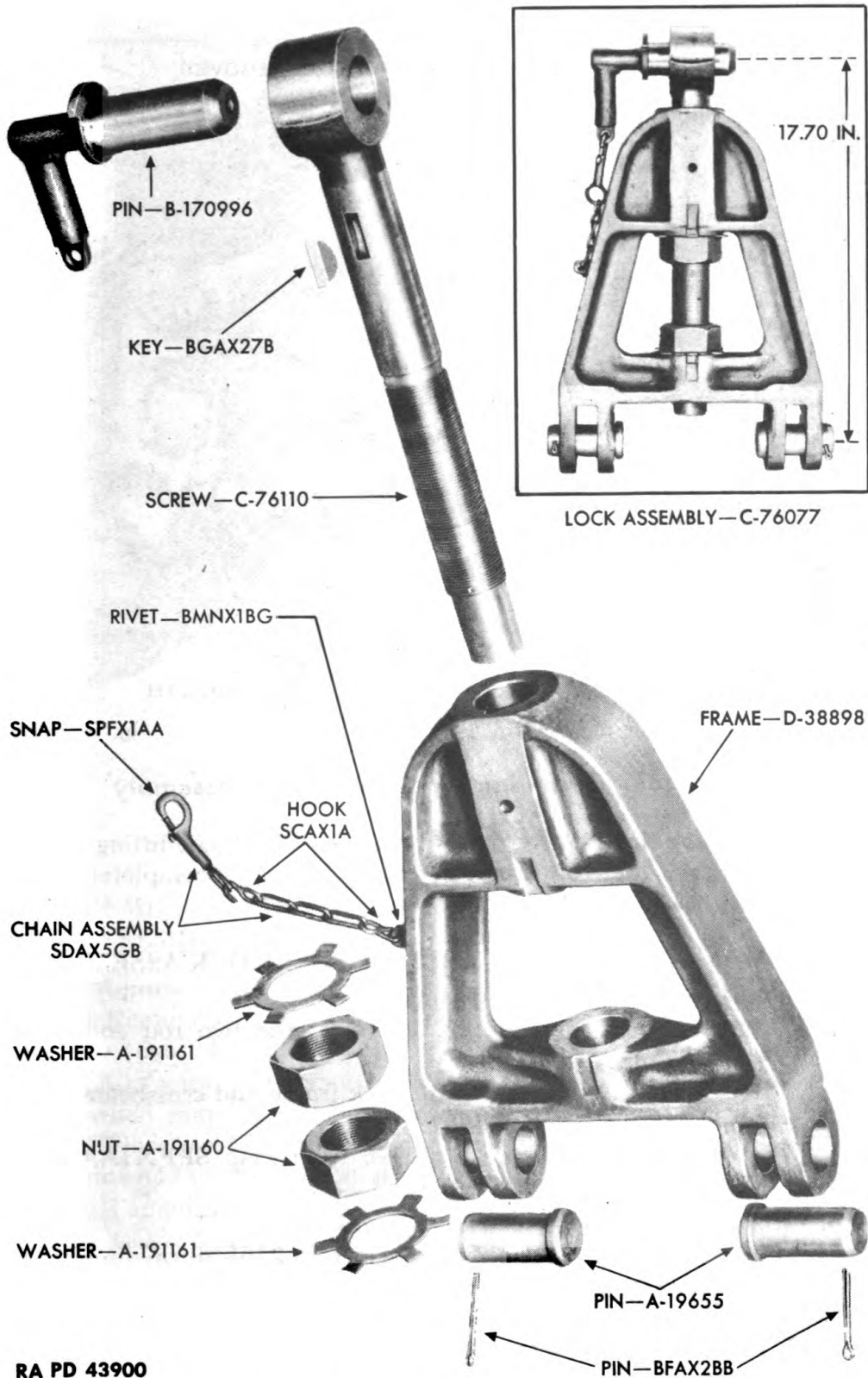


Figure 247 — Cradle Lock and Parts

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

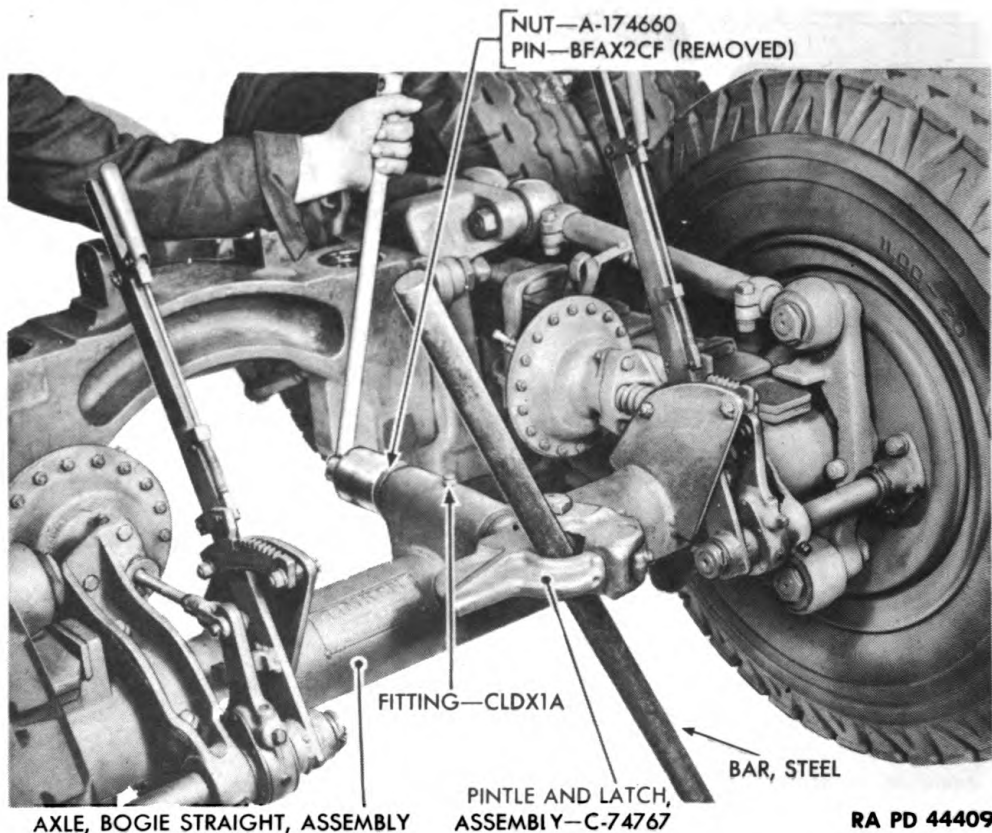


Figure 248—Removing Pintle and Latch Assembly

above, to remove the other bogie lifting screws. The bogie lifting screw mechanisms will then be removed from bogie and completely disassembled.

92. REMOVE AND DISASSEMBLE CRADLE LOCK ASSEMBLY.

a. Remove Cradle Lock Assembly.

(1) Remove cotter pins BFAX2BB from the two rod end pins A19655 (fig. 247).

(2) Tap rod end pins out of cradle lock frame and crossbeam, and remove cradle lock assembly C76077.

(3) Remove cradle lock pin B170996 from snap SPFX1AA and frame D38898.

b. Disassemble Cradle Lock Assembly.

(1) Place cradle lock assembly in a vise (fig. 246). Straighten lugs on two lock washers A191161.

(2) Remove two nuts A191160 and washers A191161 from screw C76110, and remove screw from frame D38898 (fig. 246).

(3) To remove chain assembly SDAX5GB, open hook SCAX1A nearest to frame D38898.

BOGIE

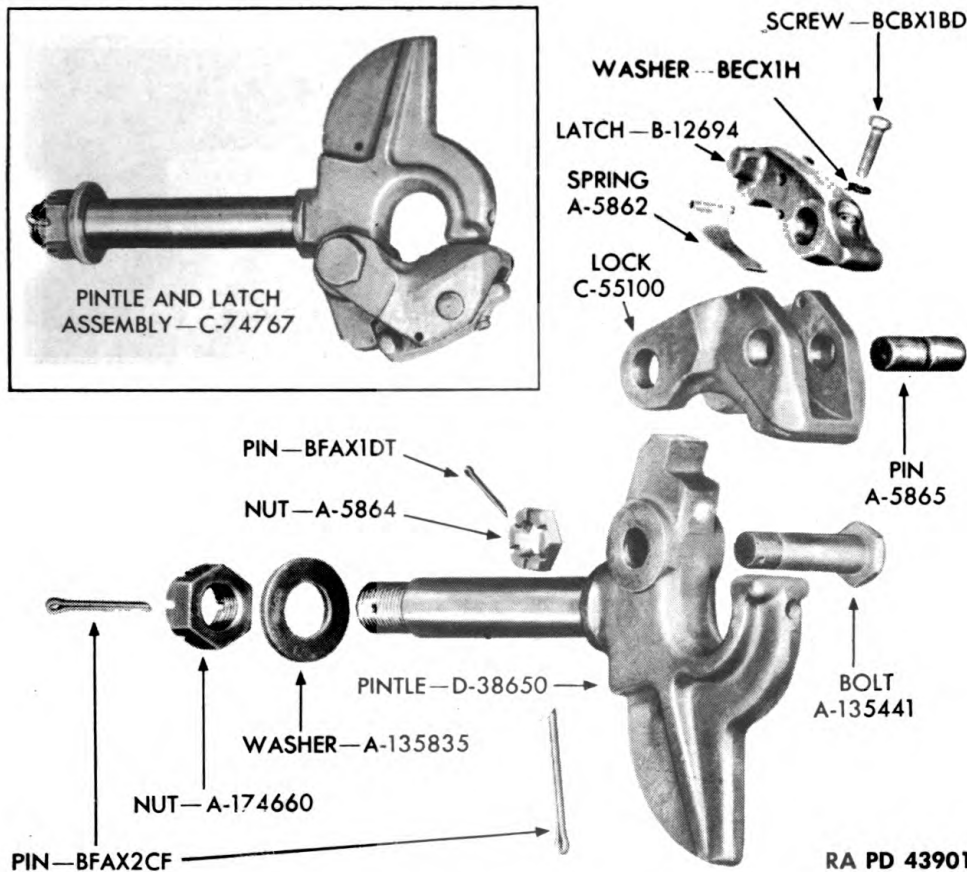


Figure 249—Pintle and Latch

93. REMOVE AND DISASSEMBLE PINTLE AND LATCH ASSEMBLY.

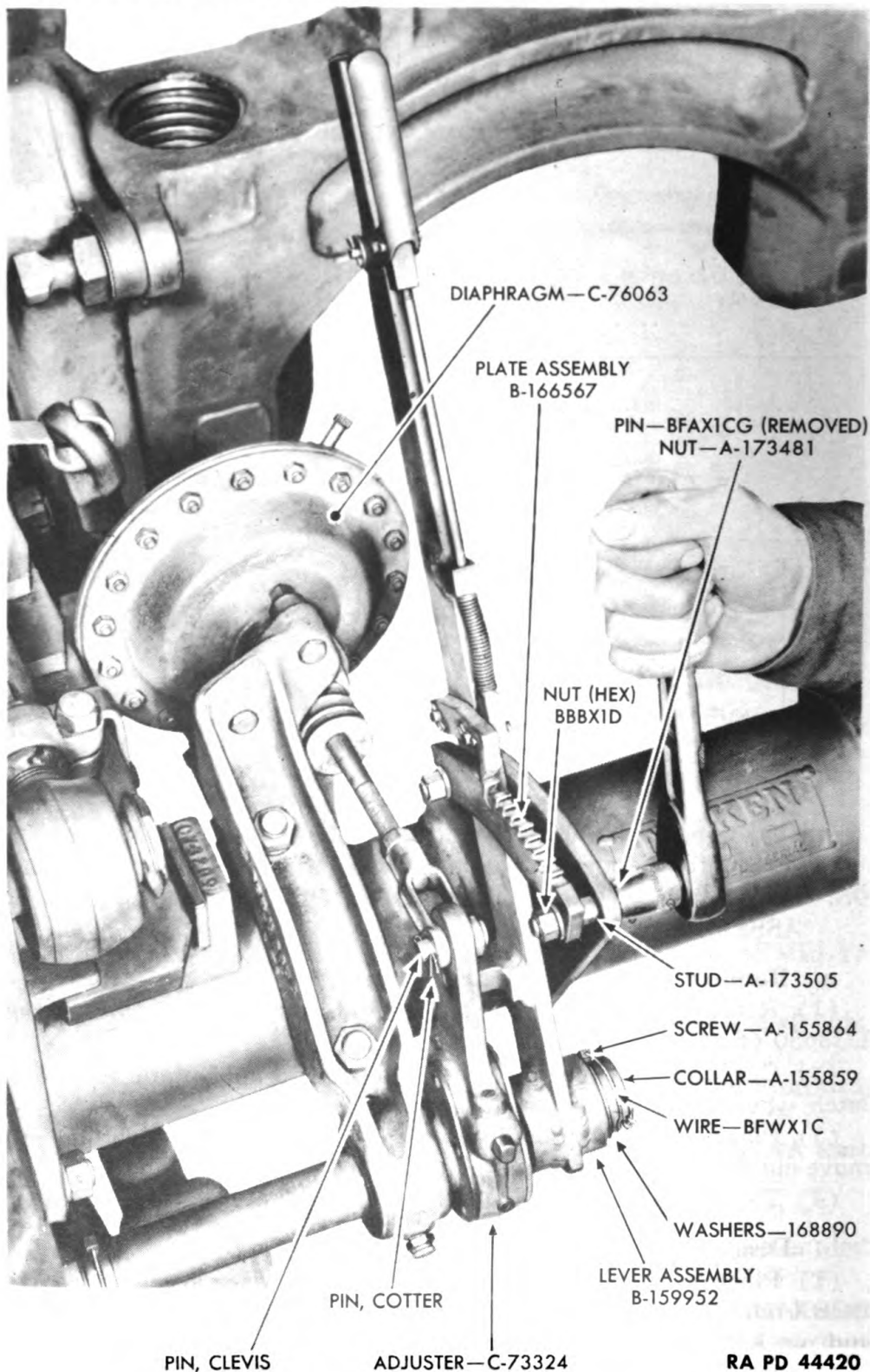
a. Remove Pintle and Latch Assembly.

- (1) Remove cotter pin BFAX2CF from nut A174660 and pintle D38650 (figs. 248 and 249).
- (2) Cut wire, and remove cotter pin used to hold pintle to pintle latch when materiel is towed by prime mover.
- (3) Place steel bar through pintle (fig. 248) and unscrew and remove nut A174660 from end of pintle D38650.
- (4) Tap pintle and latch assembly C74767 from bogie straight axle.

b. Disassemble Pintle and Latch Assembly (fig. 249).

- (1) Place pintle and latch assembly in a vise. Remove screw BCBX1BD and washer BECX1H from lock C55100, latch B12694, and pin A5865.
- (2) Push pintle latch pin A5865 out, and remove pintle latch.
- (3) Remove cotter pin BFAX1DT from nut A5864 and bolt

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



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Figure 250—Removing Hand Brake Lever Assembly

BOGIE

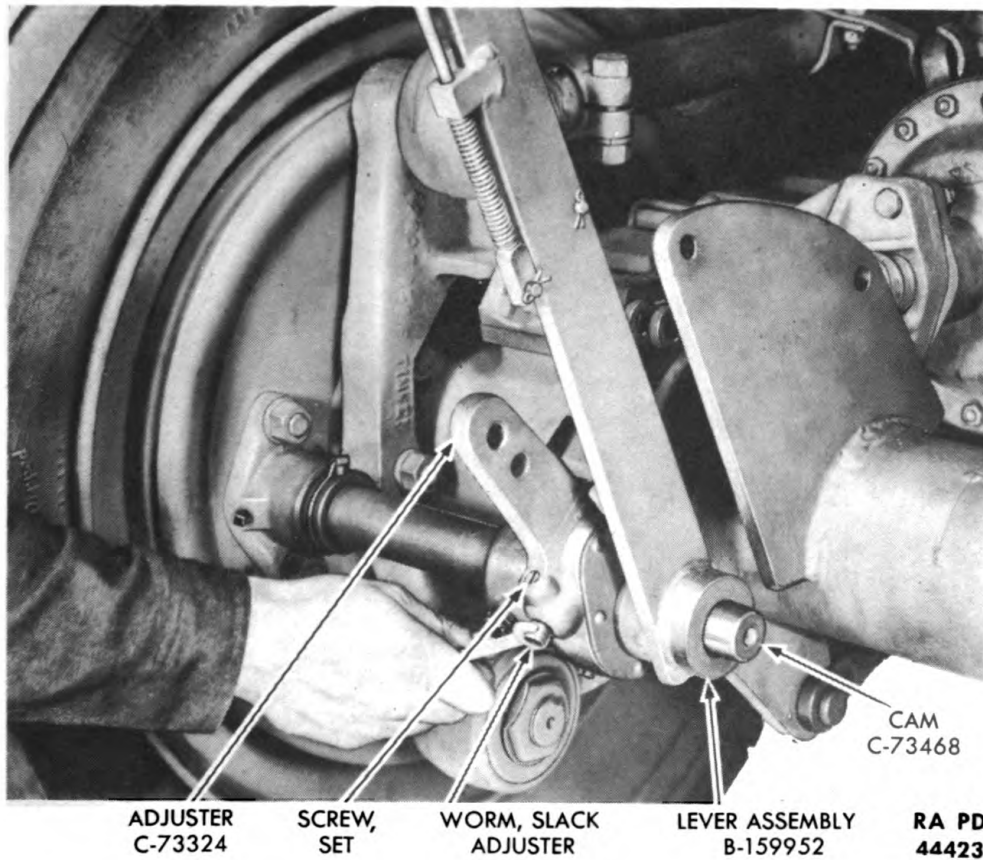


Figure 251—Turning Slack Adjuster

A135441. Remove nut from bolt. Tap out bolt, and remove pintle lock C55100 from pintle D38650.

(4) Place pintle latch B12694 in a vise and tap pintle latch spring A15862 off latch.

94. REMOVE BOGIE STRAIGHT AXLE ASSEMBLY.

a. Remove Hand Brake Lever Assemblies and Slack Adjusters.

(1) Remove two cotter pins BFAX1CG from nuts A173481 and studs A173505 (fig. 250). Remove nuts from studs.

(2) Remove hand brake lever latch plate assembly B166567.

(3) Remove cotter pin from brake diaphragm clevis or rod end pin and remove clevis pin from brake diaphragm and slack adjuster.

(4) Remove wire BFWX1C from screw A155864, and remove screw from collar A155859. Remove collar and two washers A168890 from brake operating cam. Pull hand brake lever forward until it rests against slack adjuster (figs. 250 and 251).

(5) Loosen slack adjuster set screw (fig. 251) and turn slack ad-

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

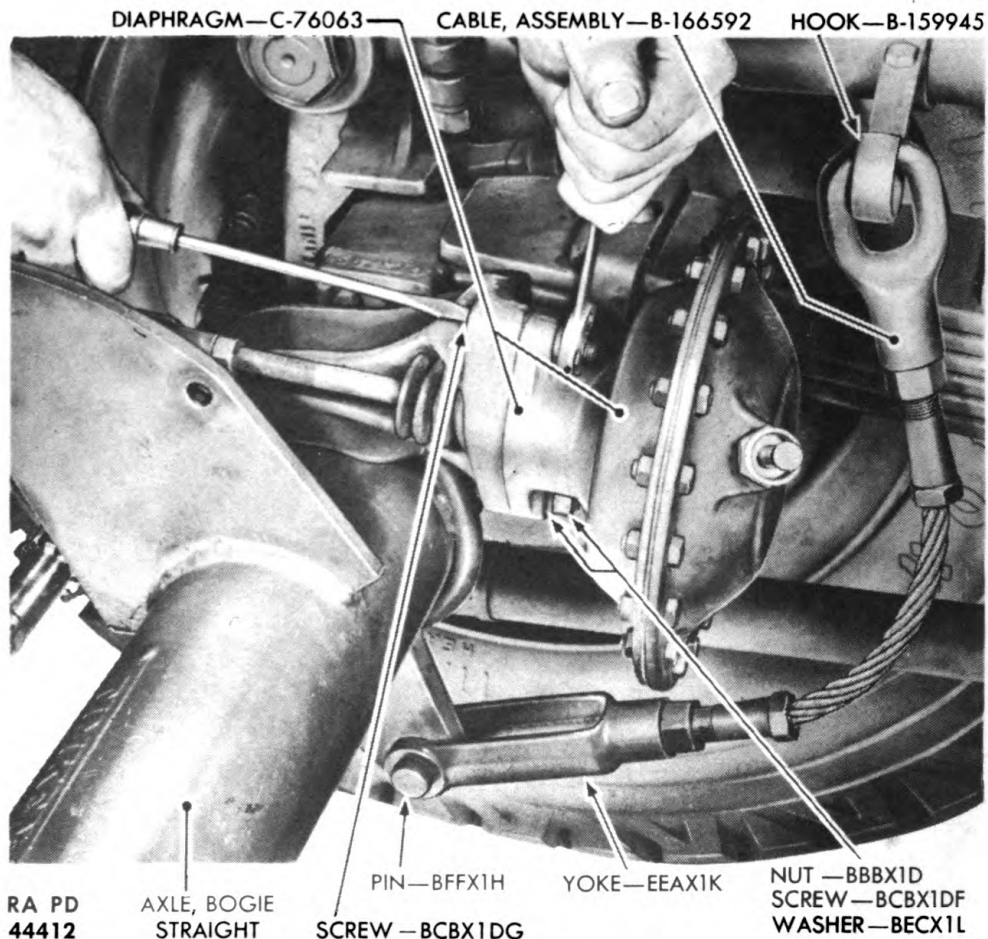


Figure 252—Removing Right Front Air Brake Diaphragm

juster worm far enough to permit removal of hand brake lever assembly. Slide lever assembly off brake operating cam.

(6) Slide slack adjuster off brake operating cam.

(7) Repeat procedure as described in steps (1) through (6) above, to remove the other hand brake lever assembly and slack adjuster.

b. Remove Front Air Brake Diaphragms.

(1) Remove three nuts BBBX1D and washers BECX1L from screw BCBX1DF and screws BCBX1DG (fig. 252). Remove three screws, and lift brake diaphragm C76063 away.

(2) Repeat procedure described in step (1) above to remove the other front brake diaphragm C73328.

NOTE: Right front and left rear brake diaphragms are interchangeable, as are the left front and right rear diaphragms.

NOTE: The hand brake lever assemblies, slack adjusters, and diaphragms are parts of the brake mechanism. Complete disassembly,

BOGIE

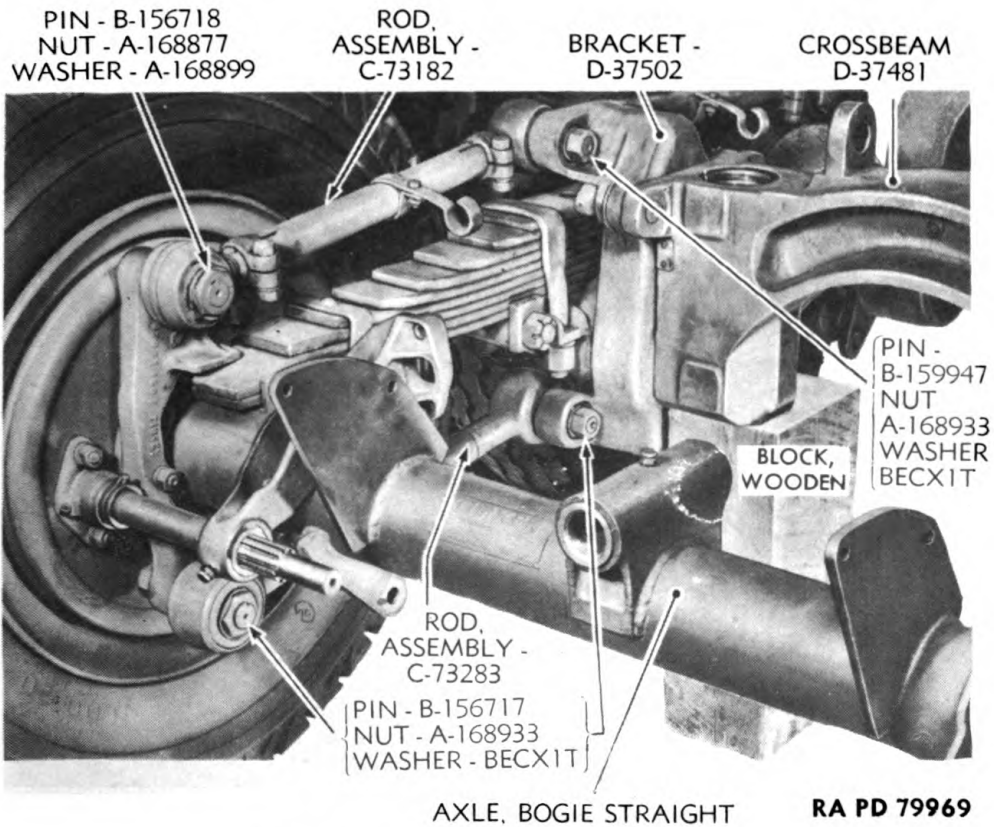


Figure 253—Bogie Torque Rods

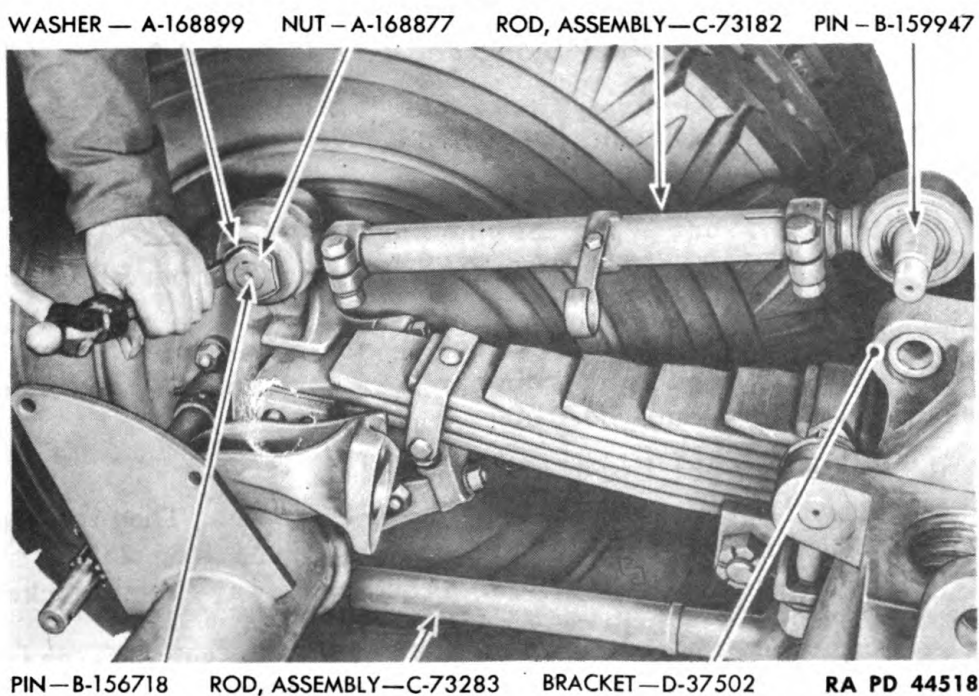


Figure 254—Straightening Washer

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

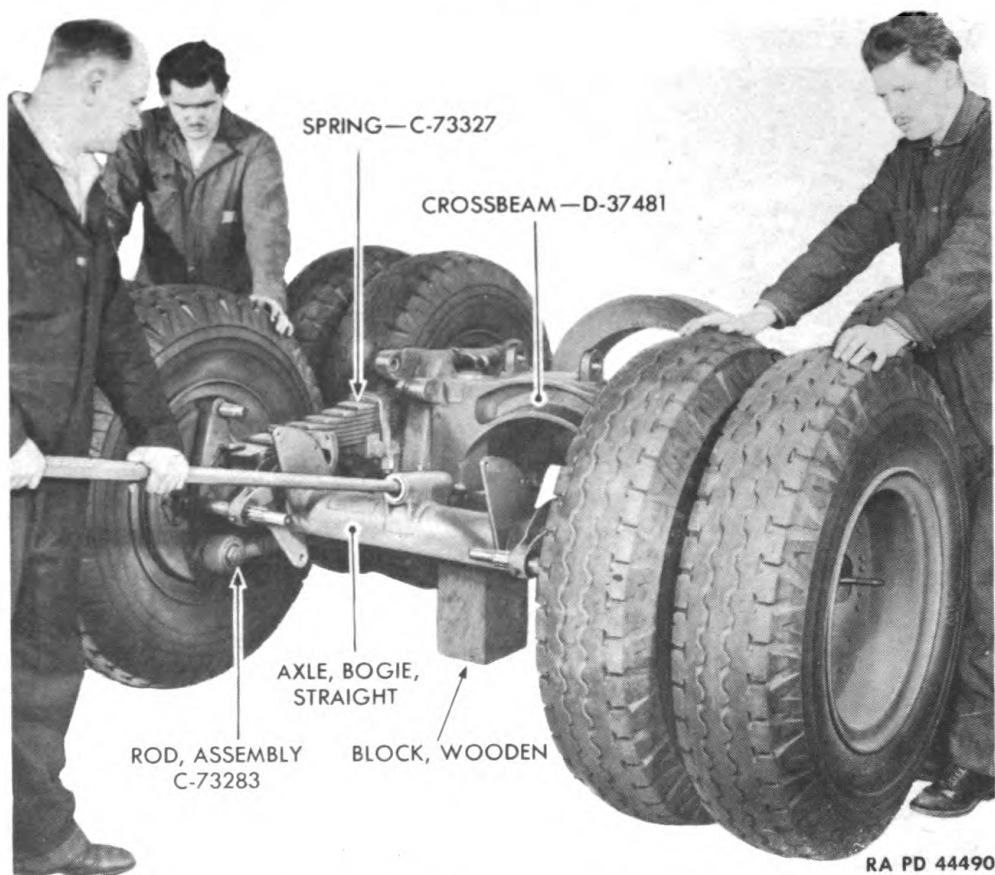


Figure 255—Removing Bogie Straight Axle

maintenance and repair, and assembly are covered in paragraphs 109, 110, and 111.

c. Remove Front Wheel Supporting Cables.

- (1) Remove cotter pin BFA1EH and tap rod end pin BFFX1H out of yoke EEAX1K (fig. 252).
- (2) Remove cable assembly B166592 from hook B159945.
- (3) Repeat procedure described in steps (1) and (2) above to remove the other front wheel supporting cable.

d. Remove Front Upper Torque Rods.

- (1) Place large wood blocks under bogie crossbeam. Then remove nut A168933 and washer BECX1T from pin B159947 (fig. 253).
- (2) Pry rear end of top front torque rod away from bracket D37502. Pin B159947 will come away in torque rod.
- (3) Free nut A168877 by straightening washer A168899 (fig. 254). Remove nut and washer from pin B156718.
- (4) Tap torque rod assembly C73182 from pin.

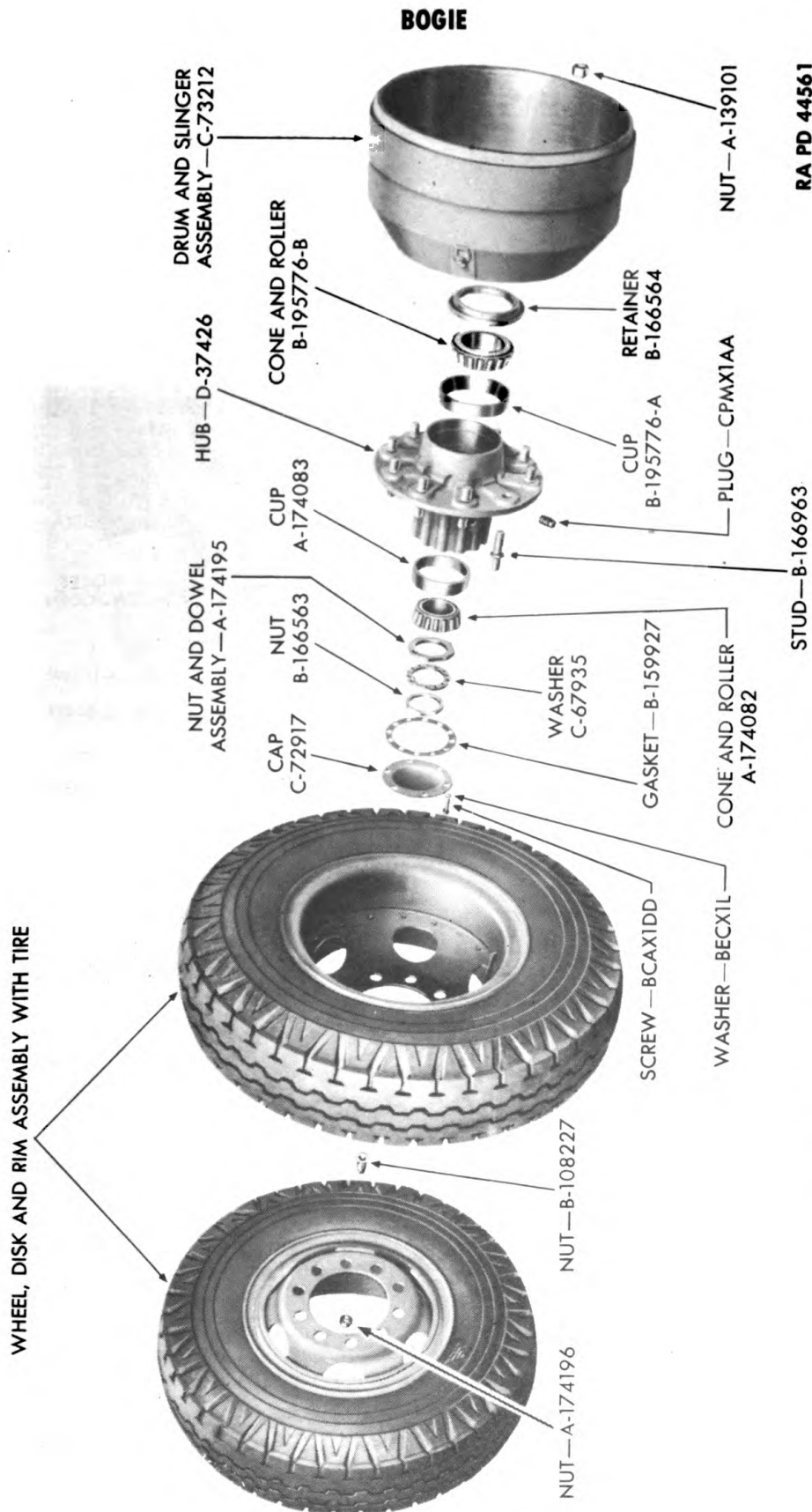
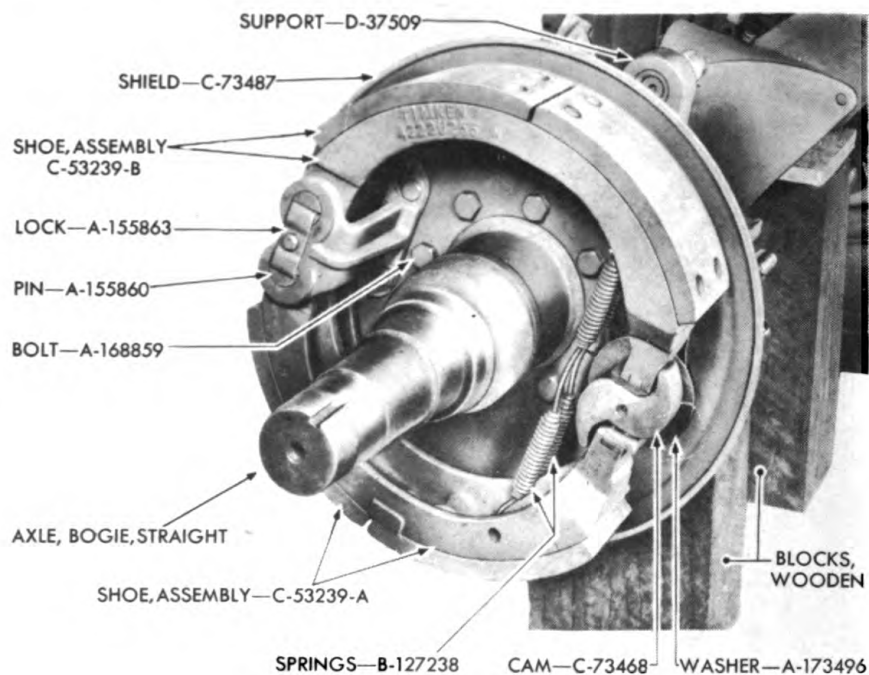


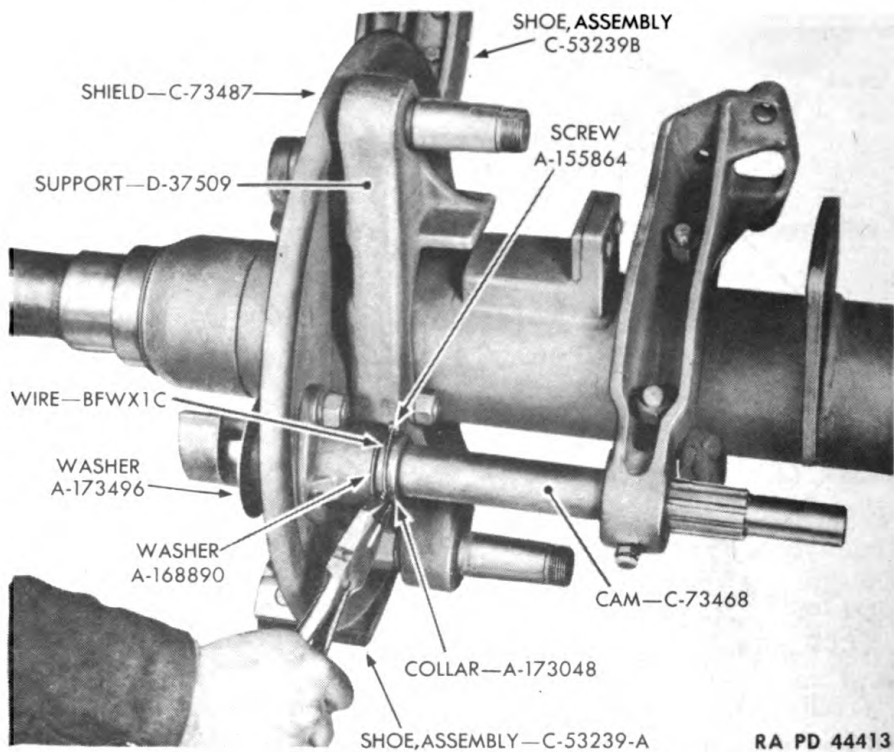
Figure 256—Bogie Right Front Dual Wheel—Exploded View

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



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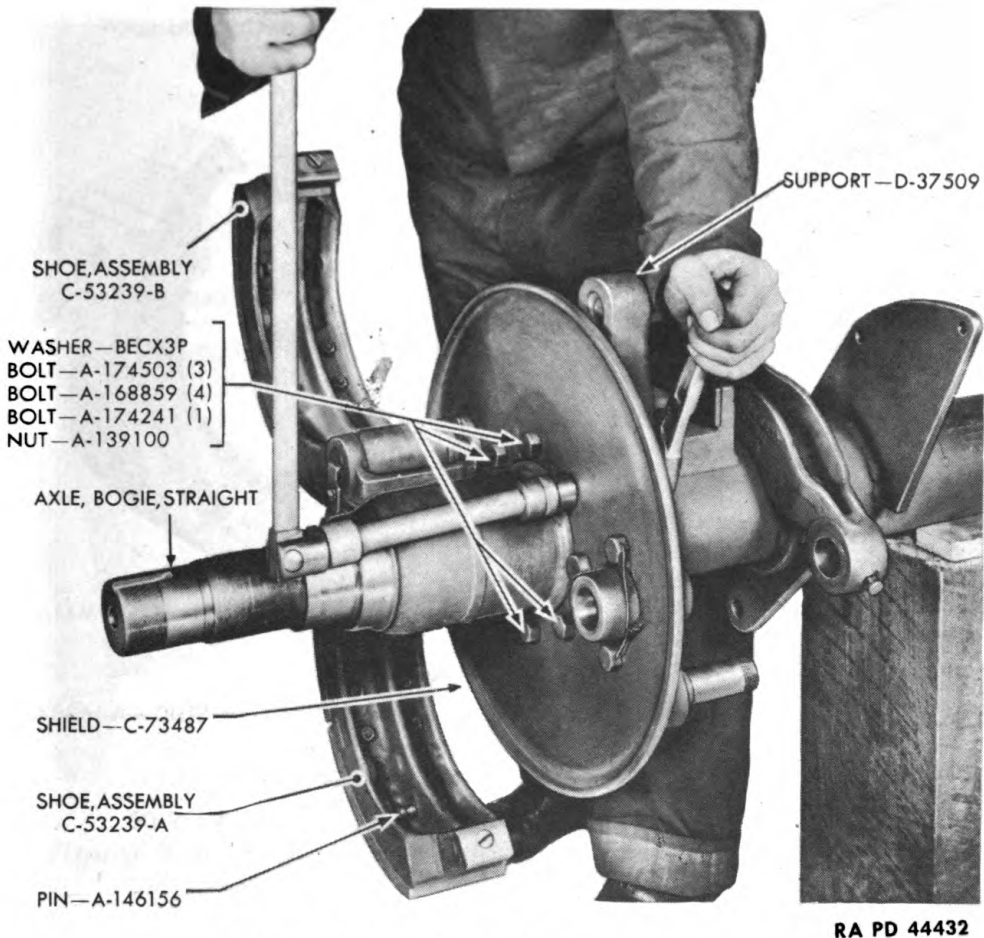
Figure 257—Brake Shoe Assembly



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Figure 258—Removing Brake Operating Cam

BOGIE



RA PD 44432

Figure 259—Removing Wheel Brake Assembly

(5) Repeat procedure as described in steps (1), (2), (3), and (4) above to remove other front upper torque rod.

e. Loosen Front Lower Torque Rods.

(1) Remove nut A168933 and washer BECX1T from lower rear pin B156717 (fig. 253). Pry rear end of lower front torque rod assembly C73283 from bracket D37502. Pin B156717 will come away in torque rod.

(2) Repeat procedure as described in step (1) above to loosen other front lower torque rod. **NOTE:** The two lower front torque rods can be removed before the bogie straight axle is removed from bogie. It is easier, however, to remove them after bogie straight axle is free from bogie.

f. Remove Bogie Straight Axle.

(1) Wrap the handle end of a pinch bar in cloth and insert it through pintle bushing at top center of bogie straight axle (fig. 255).

(2) Balance the bogie straight axle and roll it away from bogie

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

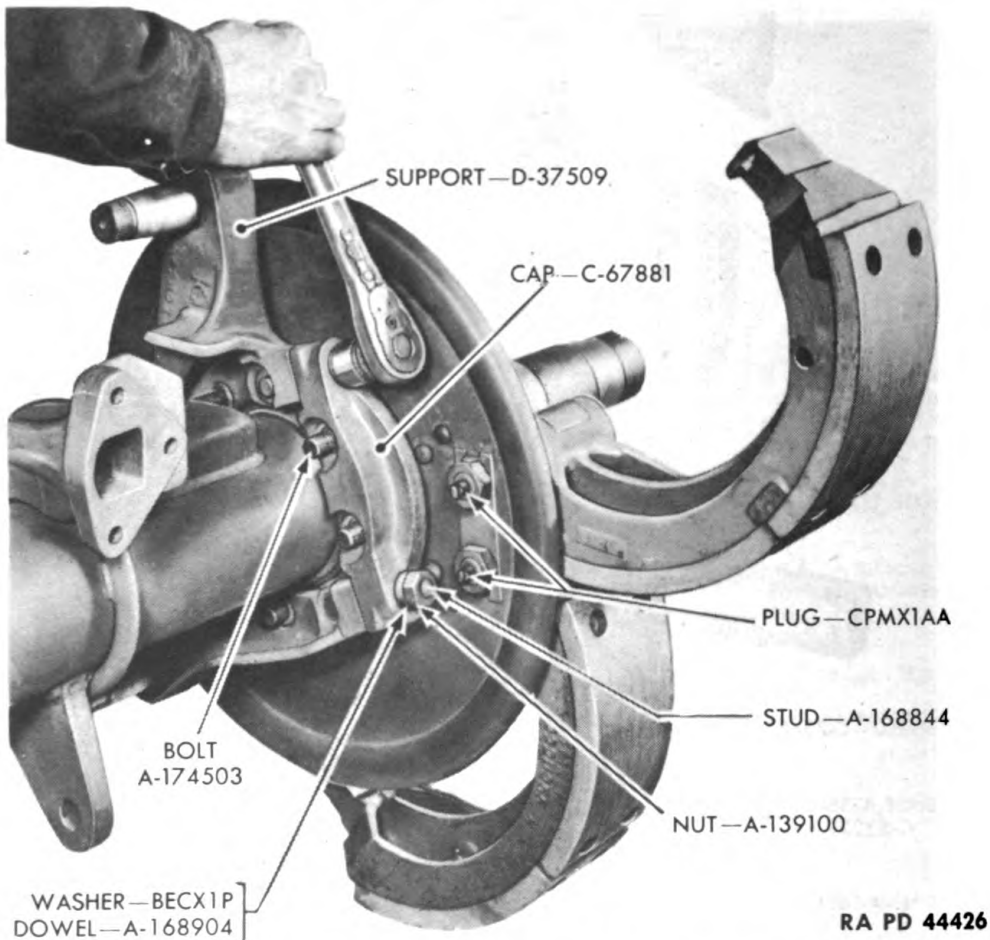


Figure 260—Disconnecting Bogie Axle Support

crossbeam (three men are required). NOTE: Front end of bogie springs will slide out of spring seats on bogie straight axle when straight axle is rolled away.

(3) Free nuts A168933 by straightening washers BECX1T. Remove nuts and washers from lower front pins B156717.

(4) Tap torque rod assemblies C73283 from pins.

95. DISASSEMBLE BOGIE STRAIGHT AXLE.

a. Remove Right and Left Dual Wheels (fig. 256) (par. 71 a, b, and c, TM 9-335 or par. 54 a (1), (2), and (3), TM 9-350).

b. Remove Right and Left Wheel Hub and Brake Drum Assemblies (par. 71 d, TM 9-335 or par. 54 a (4), TM 9-350).

c. Remove Brake Operating Cam.

(1) Unhook and remove two springs B127238 (fig. 257). Lower brake shoe will swing down. Swing upper shoe up and back away from cam.

BOGIE

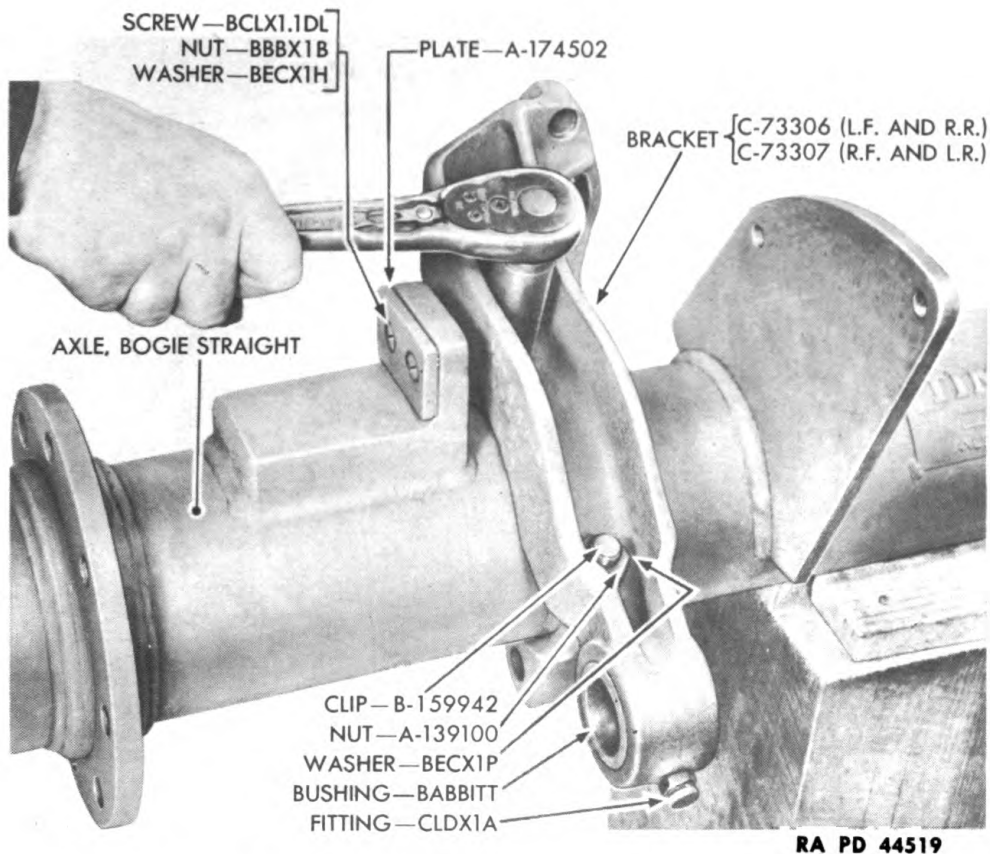


Figure 261—Removing Brake Operating Cam Bracket

(2) Remove wire BFWX1C from collar A173048 and screw A155864 (fig. 258). Remove screw.

(3) Tap cam C73468 out of bracket C73307 and shield C73487 with a copper hammer. Collar A173048, washer A168890, and washer A173496 will come away when cam is removed (figs. 257 and 258).

(4) Repeat procedure as described in steps (1), (2), and (3) above to remove other brake operating cam from bogie straight axle.

d. Remove Wheel Brake Assembly.

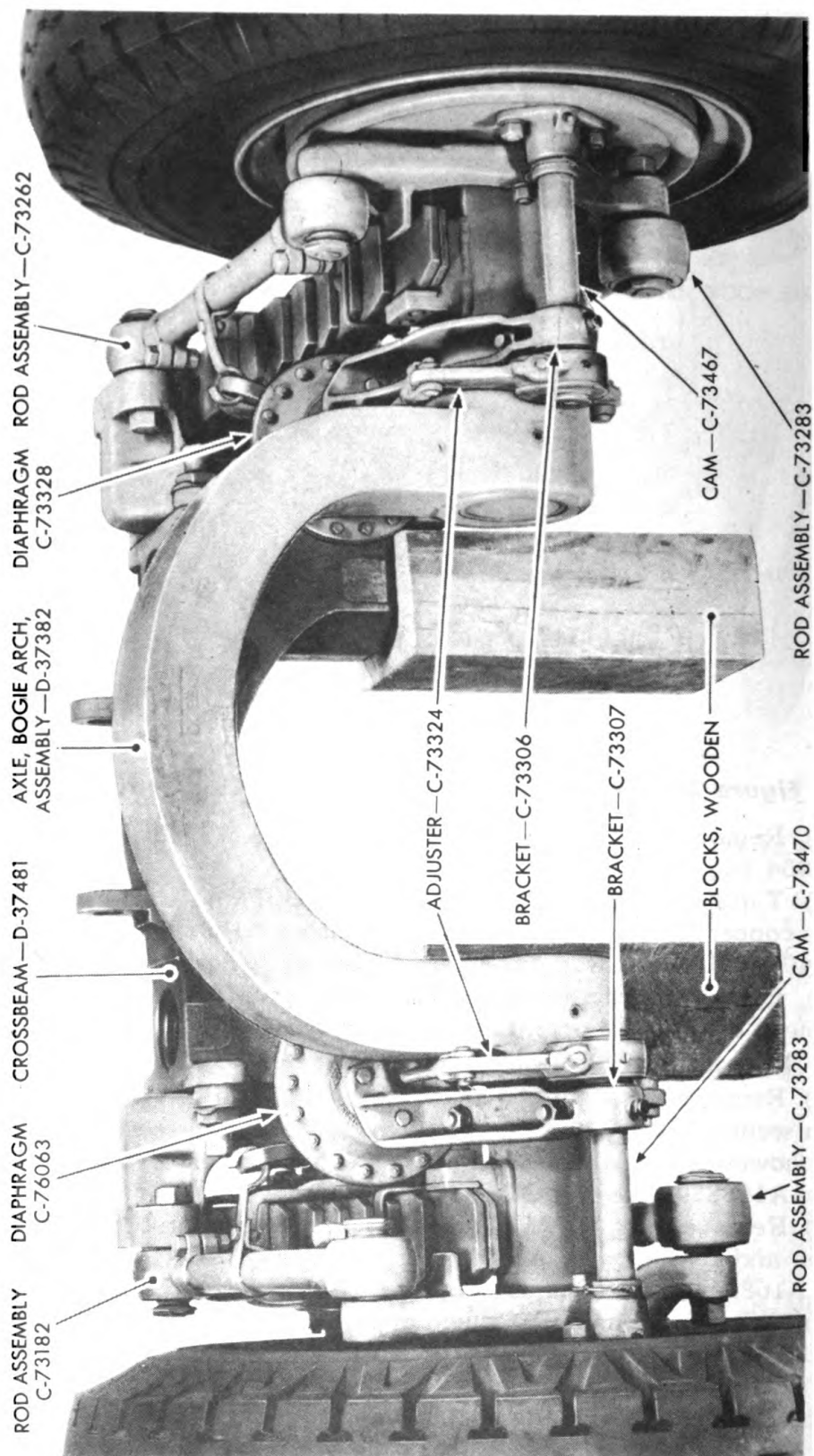
(1) Remove nuts A139100 and washers BECX3P from eight bolts which secure shield C73487 to axle (fig. 259). Do not remove bolts. Note, however, that there are three different lengths of bolts used; four of A168859, three of A174503, and one A174241.

(2) Remove plug CPMX1AA closest to lower stud A168844. Loosen and remove nuts A139100 and washers BECX1P from two studs A168844 (fig. 260).

(3) Tap eight bolts out of shield and axle flange. Then screw plug CPMX1AA back in place loosely so it will not be lost.

(4) Tap wheel brake assembly off bogie straight axle with a copper hammer. NOTE: Bogie axle support assembly will remain loose on bogie straight axle.

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



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Figure 262—Bogie Arch Axle—General View

BOGIE

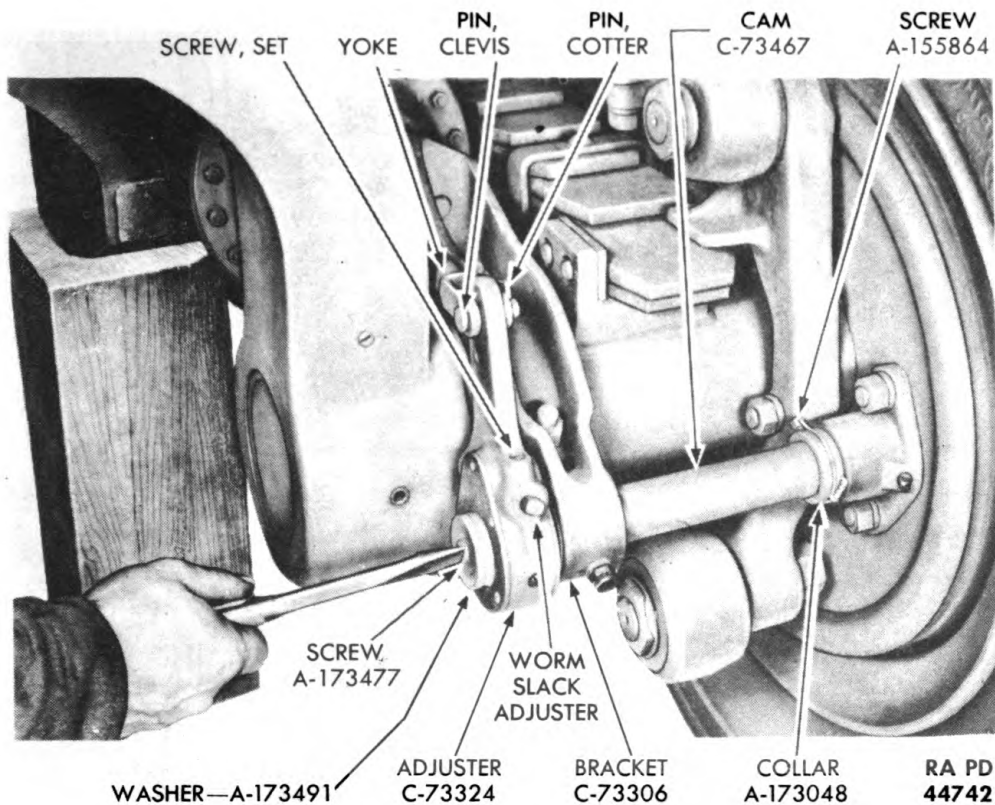


Figure 263—Removing Right Rear Slack Adjuster

(5) Repeat procedure as described in steps (1), (2), (3), and (4) above to remove other wheel brake assembly from bogie straight axle.

(6) For further disassembly, maintenance and repair, and assembly of wheel brake mechanism, see paragraphs 109, 110, and 111.

e. Remove Bogie Axle Support.

(1) Tap support cap C67881 off studs A168844 and dowels A168904 (fig. 260). Lift axle support D37509 away from axle.

(2) Repeat procedure as described in step (1) above to remove other axle support from axle.

f. Remove Brake Operating Cam Bracket.

NOTE: The U-clips B159942 which hold brake operating cam brackets on axle are welded to the axle.

(1) Remove nuts A139100 and washers BECX1P from clip B159942, and lift bracket C73306 or C73307 from axle (fig. 261).

(2) Repeat procedure as described in step (1) above to remove the other brake operating cam bracket from straight axle.

g. Remove Spring Guide Plate.

(1) Remove two screws BCLX1.1DL, nuts BBBX1B, and washers

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

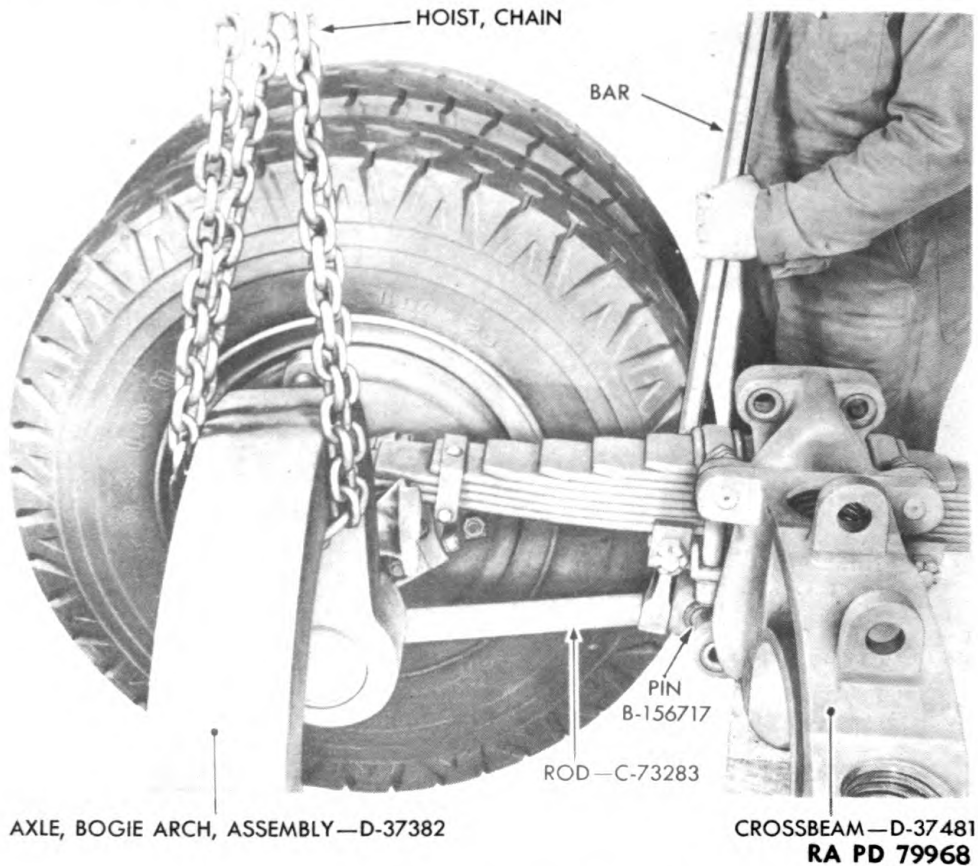


Figure 264—Removing Bogie Arch Axle

BE CX1H from plate A174502 (fig. 261). Lift plate and shims A173508 from axle.

(2) Repeat procedure as described in step (1) above to remove plate and shims from other end of axle.

h. Maintenance and repair of bogie straight axle and parts are covered in paragraph 99 f.

96. REMOVE BOGIE ARCH AXLE.

NOTE: Bogie arch axle is the rear or back axle on bogie assembly (fig. 262). The difference between the bogie axles is chiefly in their shapes. Bogie straight axle carries the two hand brake lever assemblies. The odometer is mounted in the right rear hub cap. Wheels, tires, and brake mechanism other than hand brake lever assemblies are the same.

a. Remove Slack Adjusters.

(1) Remove cotter pin from diaphragm push rod yoke clevis or rod end pin, and tap clevis pin out of yoke.

BOGIE

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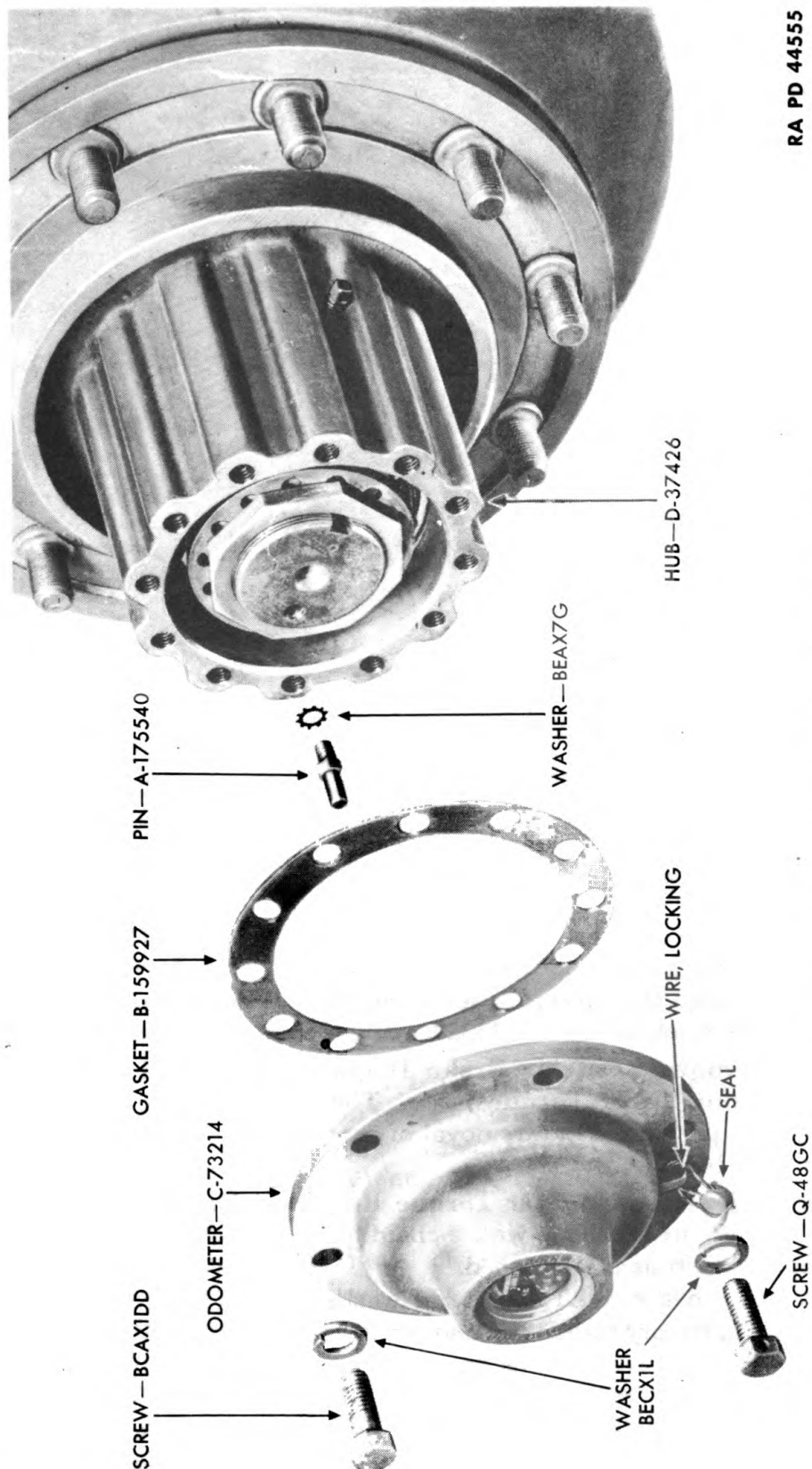


Figure 265—Wheel Hub and Odometer

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

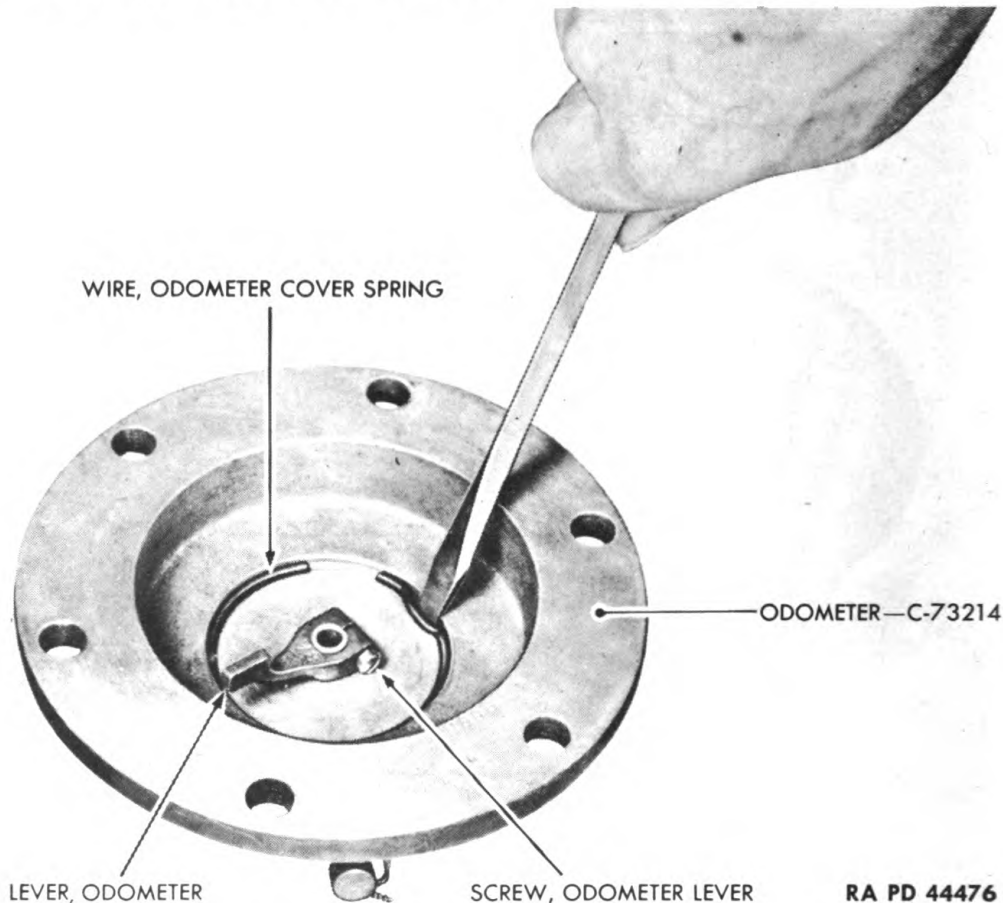


Figure 266—Removing Odometer Cover Spring Wire

(2) Remove screw A173477 and washer A173491 from cam C73467 (fig. 263).

(3) Loosen slack adjuster set screw, then turn slack adjuster worm and rotate slack adjuster C73324 enough to remove it from cam.

b. Remove Rear Air Brake Diaphragms, Wheel Supporting Cables, and Upper Torque Rods. The procedure for the removal of these is the same as for removal of similar units from bogie straight axle (par 94 b, c, and d).

c. Loosen Lower Rear Torque Rods and Remove Arch Axle.

(1) Support arch axle with a chain hoist so axle will not fall when lower torque rods are loosened.

(2) Remove nut A168933 and washer BECX1T from front pin B156717, then pry torque rod and pin from bracket D37502 (fig. 264).

(3) Repeat procedure as described in steps (1) and (2) above to loosen the other lower rear torque rod.

(4) Pull bogie arch axle assembly out from under ends of bogie springs and away from crossbeam.

BOGIE

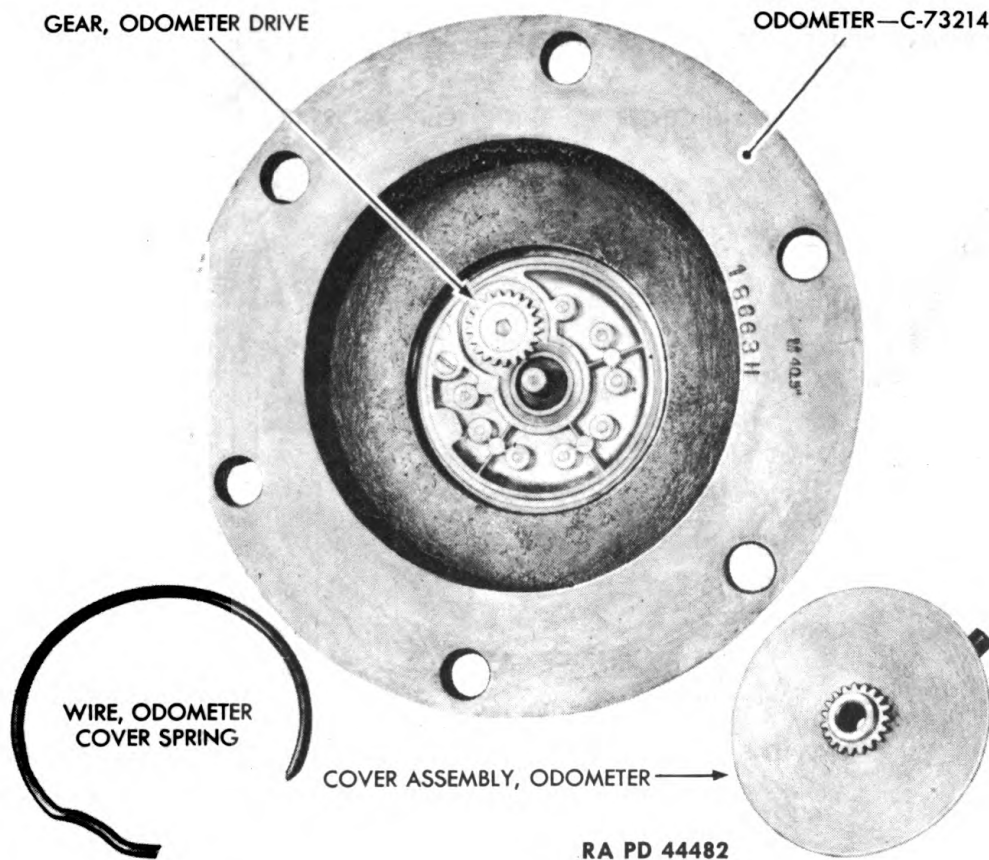


Figure 267 — Odometer Disassembled

97. DISASSEMBLE BOGIE ARCH AXLE.

a. **Remove Lower Torque Rods.** Free nut A168933 by straightening washer BECX1T. Remove nut and washer from pin B156717. Tap torque rod assembly C73283 from pin.

b. **Remove Right and Left Dual Wheels.** The procedure for removing the dual wheels from bogie arch axle is the same as that for removing dual wheels from bogie straight axle (par. 71 a, b, and c, TM 9-335 or par. 54 a (1), (2), and (3), TM 9-350).

c. Remove Rear Wheel Hub and Drum Assemblies.

(1) The procedure for removal of left rear wheel hub and drum assembly from bogie arch axle is same as that for removing the wheel hub and drum assembly from the bogie straight axle (par. 71 d, TM 9-335 or par. 54 a (4), TM 9-350).

(2) The procedure for removal of right rear wheel hub and drum assembly is similar, except that it is necessary to remove odometer pin A175540 (fig. 265).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

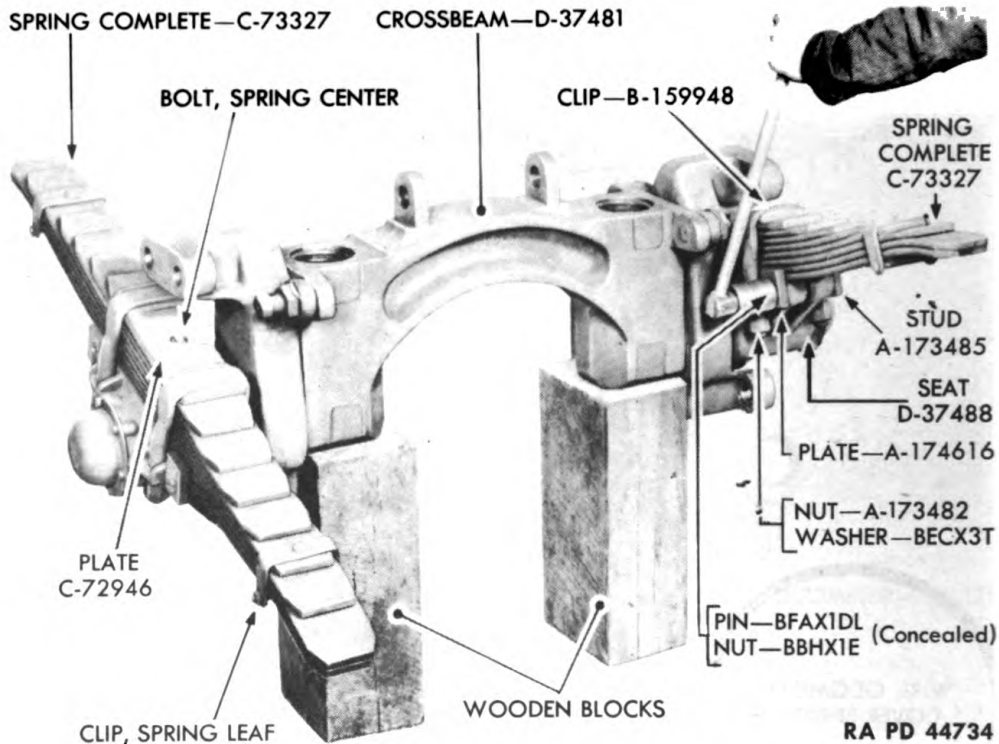


Figure 268—Removing Bogie Springs

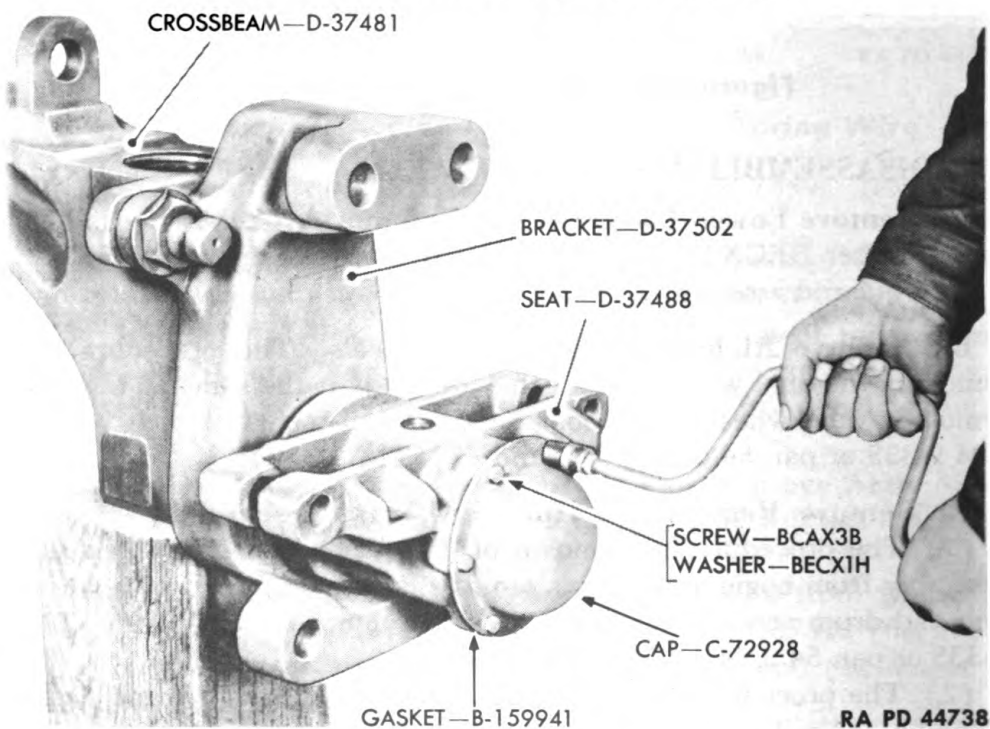


Figure 269—Removing Bogie Spring Seat Hub Cap

BOGIE

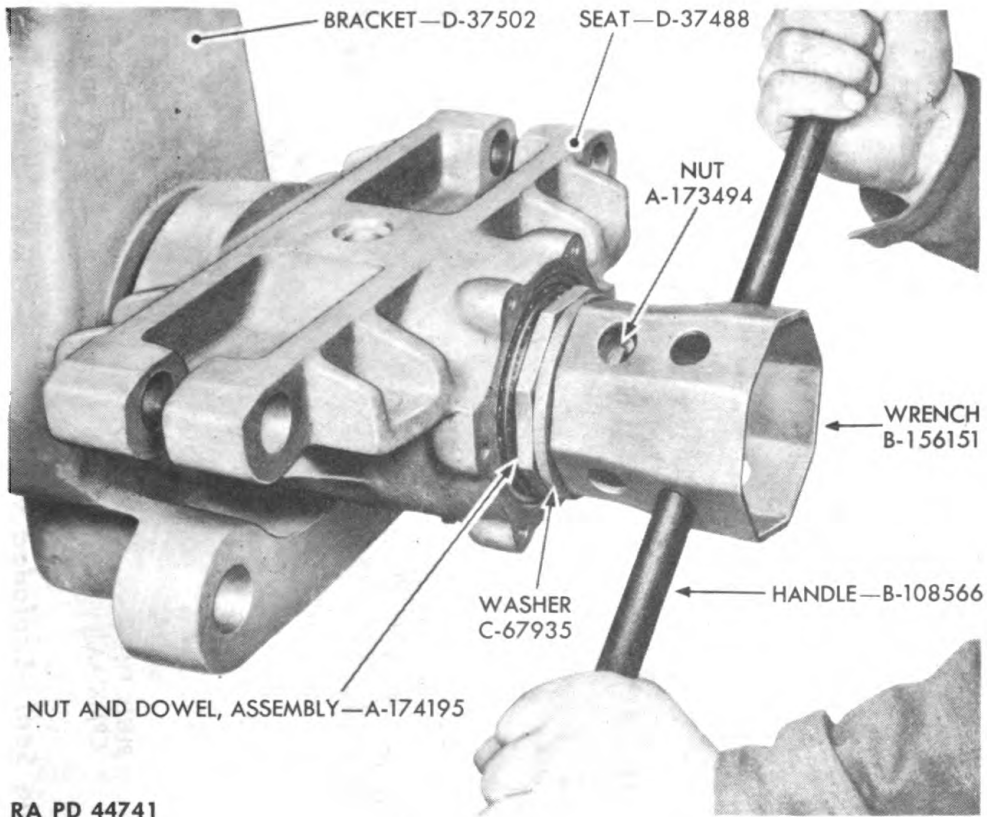


Figure 270—Removing Bogie Crossbeam Jam Nut

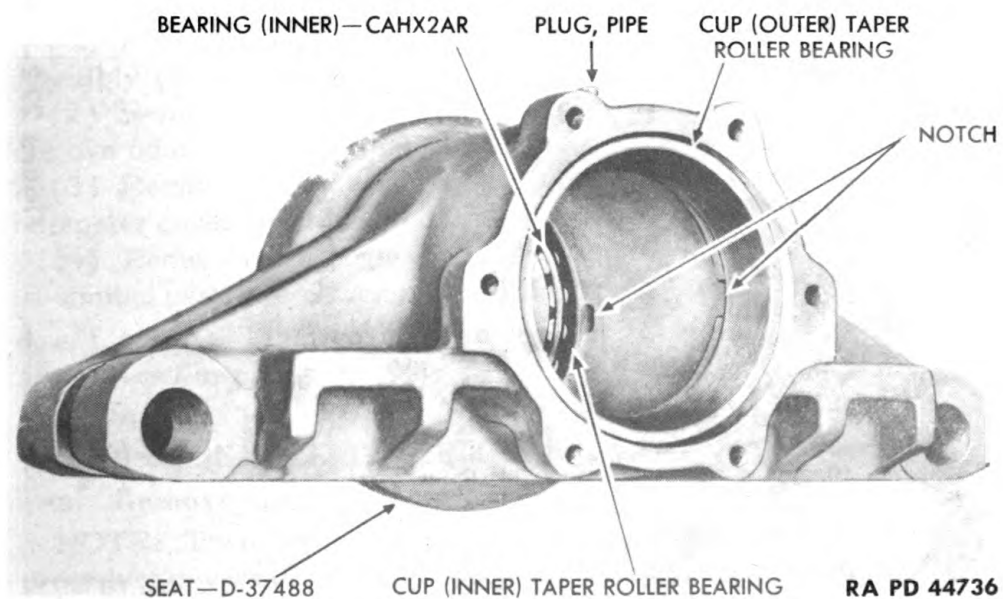


Figure 271—Notches in Bogie Spring Seat

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

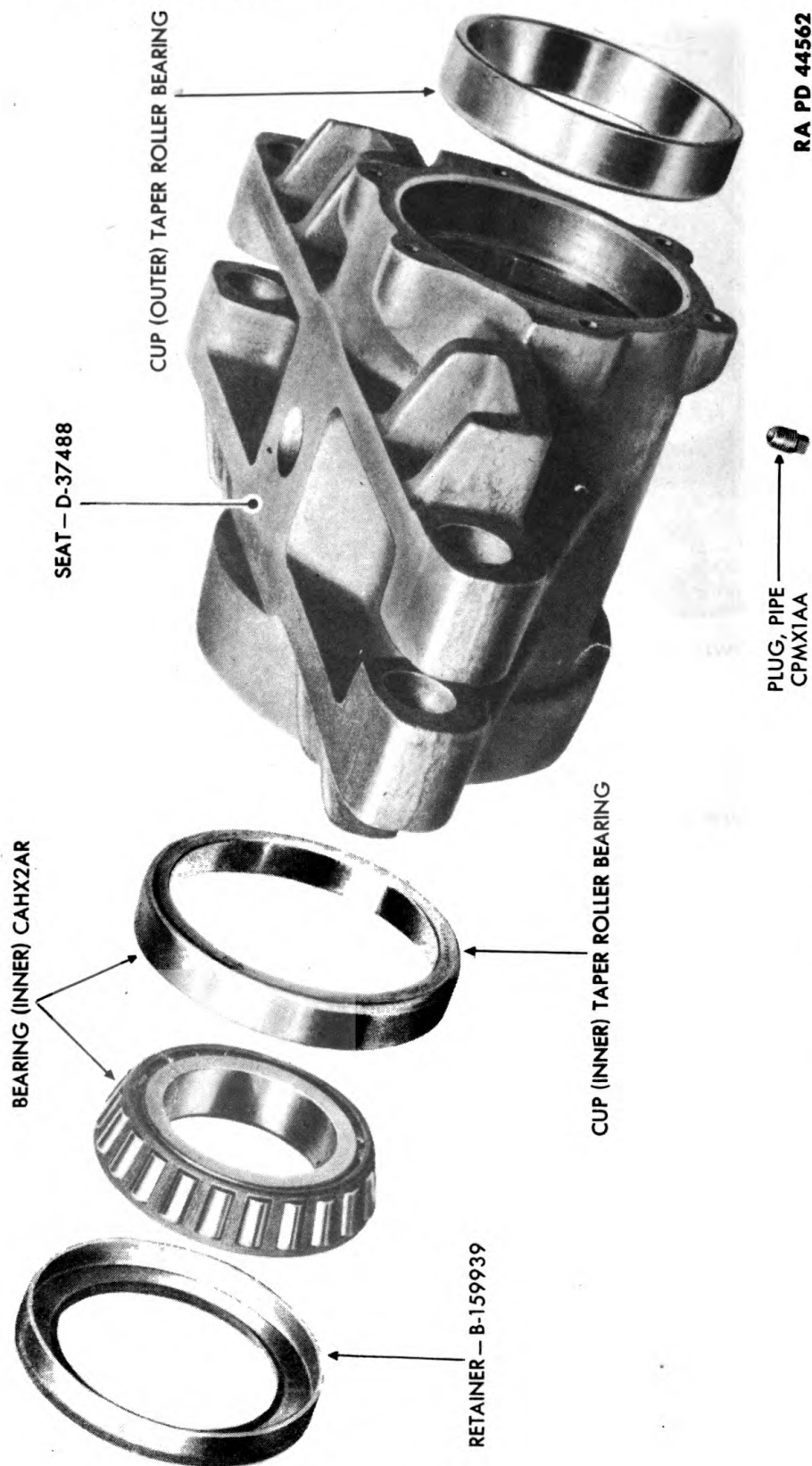
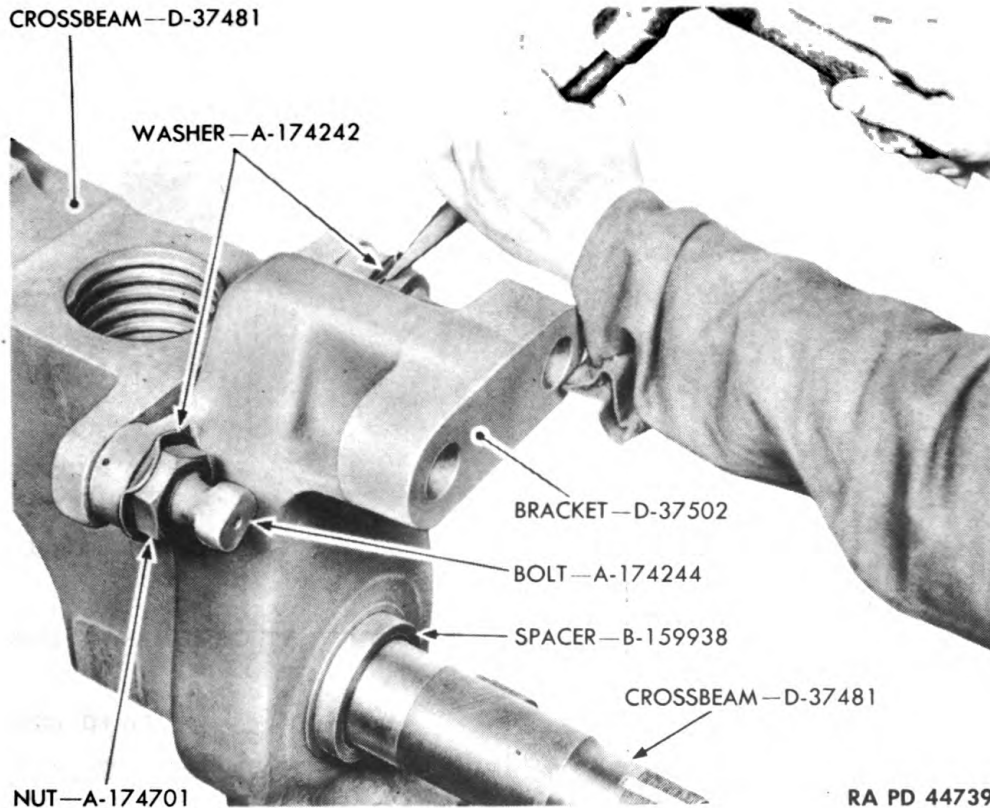


Figure 272—Bogie Spring Seat—Exploded View

BOGIE



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Figure 273—Loosening Torque Bracket Bolt Lock Washer

d. Disassemble Odometer.

(1) Pry odometer cover spring wire out of inside of odometer assembly (fig. 266).

(2) Remove odometer cover assembly from odometer body and remove odometer drive gear from odometer body (fig. 267).

(3) Remove odometer lever clamp screw and lock washer from odometer cover and lift off odometer lever.

(4) Remainder of bogie arch axle is disassembled in same manner as similar parts are disassembled from bogie straight axle (par. 95 c, d, e, f, and g). Maintenance and repair of bogie arch axle and parts are covered in paragraph 99.

98. DISASSEMBLE BOGIE CROSSBEAM.

a. Remove Bogie Springs.

NOTE: There are two bogie springs to be removed. The following procedure covers one spring; repeat to remove other spring.

(1) Remove two cotter pins BFAX1DL from two slotted nuts BBHX1E and bogie spring seat studs A173485, and then remove two

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

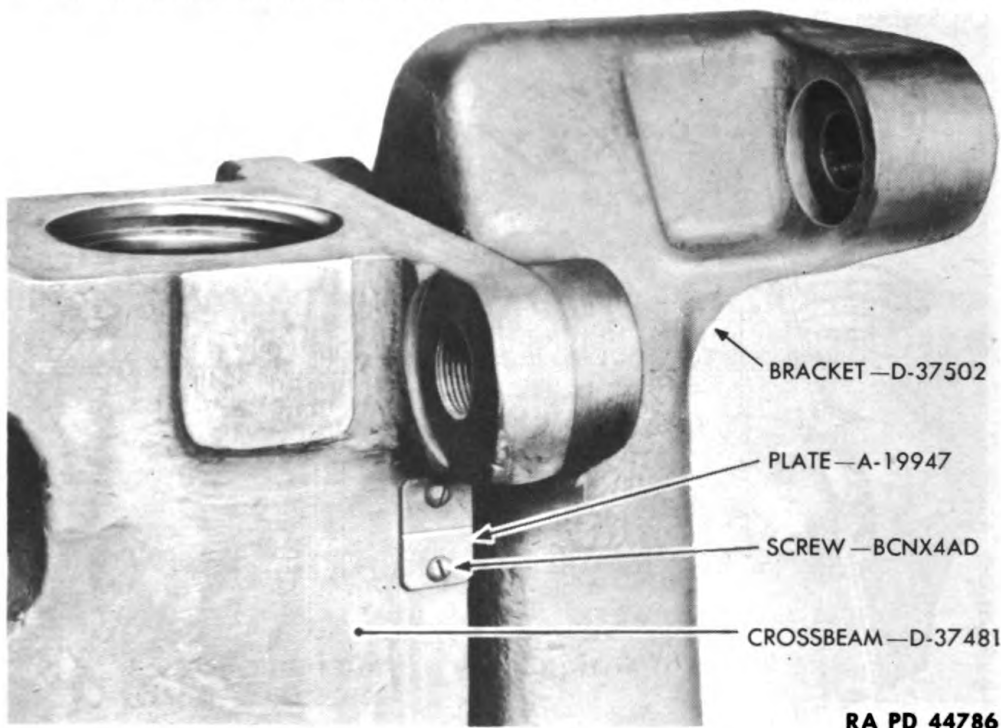


Figure 274—Indicator Plate

slotted nuts. Rotate one spring up and one down to provide leverage against bogie crossbeam (figs. 268 and 278).

(2) Pull two bogie spring seat stud plates A174616 off two bogie spring seat studs, and then pull two bogie spring seat studs out of bogie spring seat D37488.

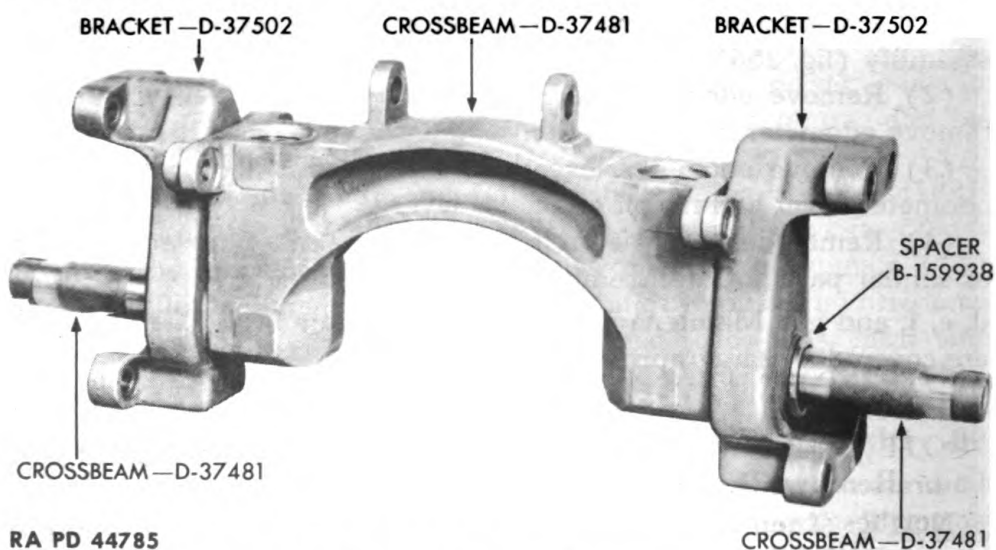


Figure 275—Bogie Crossbeam Assembly

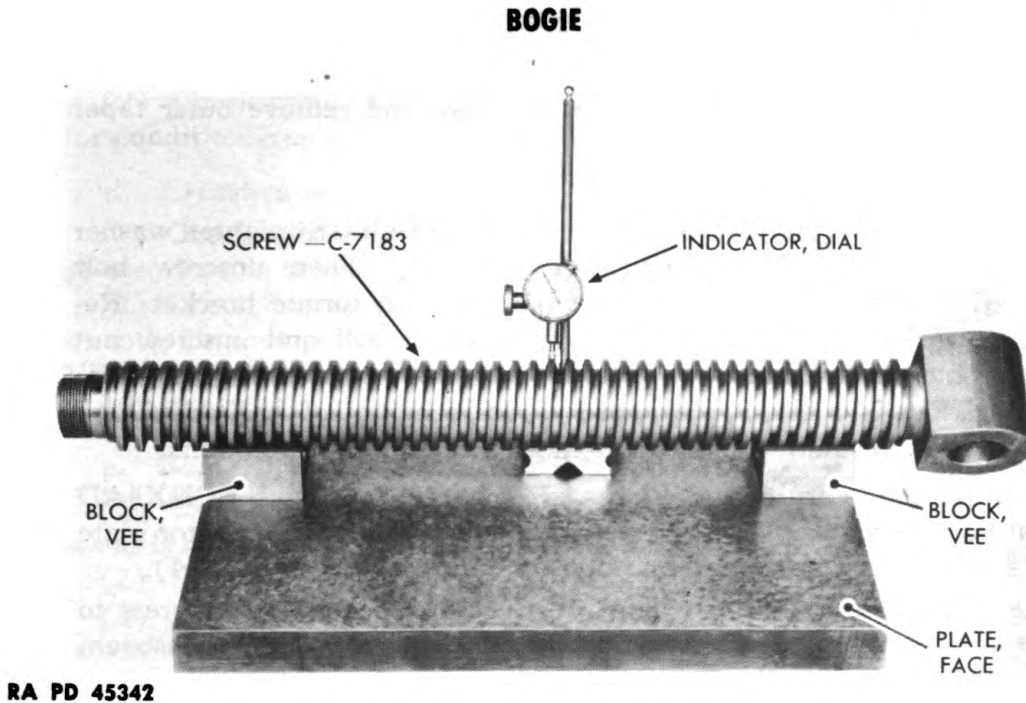


Figure 276—Inspecting Bogie Lifting Inner Screw

(3) Remove four bogie spring clip nuts A173482 and lock washers BECX3T, and drive two bogie spring clips B159948 up and off bogie springs. Lift bogie spring clip plate C72946 off spring and lift bogie spring C73327 off bogie spring seat. **NOTE:** Bogie spring leaves are held together by a spring center bolt and two spring leaf clips.

b. Remove Bogie Spring Seat.

NOTE: The following procedure covers removal of one bogie spring seat. Repeat to remove opposite seat.

(1) Remove screws BCAX3B and lock washers BECX1H that hold hub cap on bogie spring seat, and then lift off hub cap C72928 and hub cap gasket B159941 (figs. 269 and 277).

(2) Remove nut A173494 with small end of spindle nut wrench B156151 and handle B108566, and lift crossbeam spindle washer C67935 off bogie crossbeam D37481 (fig. 270).

(3) Remove nut and dowel assembly A174195 from bogie crossbeam with large end of spindle nut wrench and handle. Pull cone and roller from taper roller bearing B167070 (outer).

(4) Lift bogie spring seat D37488 assembly off crossbeam torque bracket D37502.

NOTE: There are four notches in bogie spring seat to permit use of a brass drift and hammer to remove two taper roller bearing cups, two notches at top of bogie spring seat, and two at bottom. Remove oil retainer B159939 (fig. 272), cone and roller (inner), and taper roller bearing cup (inner) in one operation, by tapping on brass drift with a hammer, first in one notch and then in opposite notch (fig. 271).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

(5) Turn bogie spring seat upside down and remove outer taper roller bearing cup.

(6) Remove pipe plug.

c. Remove Crossbeam Torque Bracket Bolts. Straighten washer A174242 (fig. 273). Loosen nut A174701. Then unscrew bolt A174244 with nut and washer from crossbeam torque bracket. Remove washer from crossbeam torque bracket bolt and unscrew nut from bolt.

NOTE: The above procedure covers removal of one crossbeam torque bracket bolt; repeat procedure on remaining three bolts.

d. Remove Indicator Plates. Remove two screws BCNX4AD that hold indicator plate to bogie crossbeam and lift off indicator plate A19947. Repeat procedure on opposite indicator plate (fig. 274).

e. Remove Crossbeam Torque Bracket. Use an arbor press to press crossbeam torque bracket D37502 from bogie crossbeam D37481. Remove roller bearing spacer from bracket (fig. 275).

NOTE: The above procedure covers removal of one crossbeam torque bracket; repeat for removing other bracket.

99. MAINTENANCE AND REPAIR OF BOGIE.

NOTE: Disassembly, maintenance and repair, and assembly of units such as hand brake levers, slack adjusters, brake shoes and drums, wheel hubs and bearings, etc., which are parts of either the brake mechanism or wheel and tire groups, are covered in paragraphs 109, 110, and 111.

a. General.

- (1) Clean all parts thoroughly in **SOLVENT**, dry-cleaning.
- (2) Examine all parts carefully for wear and damage.
- (3) Replace all damaged or badly worn parts with new parts.
- (4) Replace all cotter pins, gaskets, and oil retainers with new parts.

b. Bogie Lifting Screws.

(1) Examine threads of bogie lifting inner and outer screws for burs. Remove burs with a smooth file, and polish with **CLOTH**, crocus. Then be sure to clean the screw in **SOLVENT**, dry-cleaning.

(2) Place each lifting screw in vee blocks mounted on a surface plate. Using a dial indicator, with indicator plunger just touching screw threads, check the alinement of each screw by rotating screw and moving dial indicator the full length of the threads (fig. 276).

(3) Screws out of alinement must be replaced.

c. Cradle Lock.

(1) Check condition of cradle lock screw threads. If necessary, use a thread die to remove burs or straighten threads. Replace a cradle lock screw that has badly damaged threads.

BOGIE

(2) Check cradle lock frame, cradle lock pin, and chain assembly for condition. Replace when badly worn or damaged.

d. Crossbeam.

(1) Check condition of lifting screw mating threads. Remove burs as described in subparagraph b (1) above.

(2) Check crossbeam ends for scores and bruises. Remove with smooth file and polish with CLOTH, crocus. Then clean with SOLVENT, dry-cleaning.

(3) Replace a cracked or broken crossbeam with a new one.

e. Bogie Springs, Seats, and Clips.

(1) Examine springs carefully for broken leaves. Replace spring if a leaf is broken. Tighten center bolts if loose.

(2) Replace cracked or broken spring seats.

(3) Repair threads on spring clips if burred. Use a thread die to condition threads. Straighten a slightly bent clip.

f. Bogie Straight Axle.

(1) Examine carefully for cracks, broken welds, or other damage. When badly damaged, replace axle with a new one.

(2) Slight damage, insufficient to cause trouble in future service, may be repaired by welding.

(3) Scored bearing surfaces on axle ends, when not too badly scored, can be corrected by filing with smooth file and polishing with CLOTH, crocus. Then clean with SOLVENT, dry-cleaning. File just enough to remove score or bur.

(4) Check condition of axle end threads. When necessary, renew with thread die.

(5) To replace a worn pintle bushing A174674, remove worn bushing using a chisel and hammer. Coat outer surface of new bushing with LEAD, white, and press bushing in place in an arbor press or drive it in with a block of wood and hammer. Then ream bushing to size, 1.746-inch inside diameter.

g. Bogie Arch Axle. Repeat procedure as described in subparagraph f (1) through (4) above.

h. Torque Rods.

(1) Check condition of torque rod seat and filler. When deteriorated or cracked, replace seat and filler (metal and rubber) with a new seat and filler. Remove nut. Press out torque rod end pin and washer. Then press out seat and wedge.

(2) Place new seat in position in torque rod end. Press wedge back in place. Drive torque rod end pin and washer in place in the seat in the rod end. Replace nut.

(3) Renew threads of torque rod end pins.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

i. Wheel Supporting Cables.

- (1) Check carefully condition of cables.
- (2) Replace cable having broken strands.
- (3) Replace worn, bent, or damaged yokes and eyes (fig. 282).

100. ASSEMBLE BOGIE CROSSBEAM.

a. Install Crossbeam Torque Bracket.

NOTE: The following procedure covers installation of one crossbeam torque bracket. Repeat procedure for installation of the other bracket.

(1) Coat outside surface of roller bearing spacer with **TALLOW**, mutton, refined, or **LEAD**, white, and press it into place in crossbeam torque bracket (fig. 275).

(2) Coat the mating surfaces of crossbeam torque bracket and crossbeam with light film of **TALLOW**, mutton, refined, or **LEAD**, white, and press torque bracket onto crossbeam (fig. 277).

b. Install Indicator Plates.

(1) Coat threads of indicator plate retaining screws with **COMPOUND**, rust-preventive, light. Secure each indicator plate to bogie crossbeam with two retaining screws.

c. Install Crossbeam Torque Bracket Bolts.

NOTE: The following procedure covers installation of one crossbeam torque bracket bolt. Repeat same procedure to install the other three.

(1) Coat threads of bolt with **COMPOUND**, rust-preventive, light, and screw nut on bolt. Place washer on bolt.

(2) Screw bolt, nut, and washer into place in crossbeam torque bracket. Tighten nut against washer. Then bend washer down against flat of nut (fig. 273).

d. Install Bogie Spring Seat.

NOTE: The following procedure covers installation of one bogie spring seat. Repeat procedure to install the other spring seat.

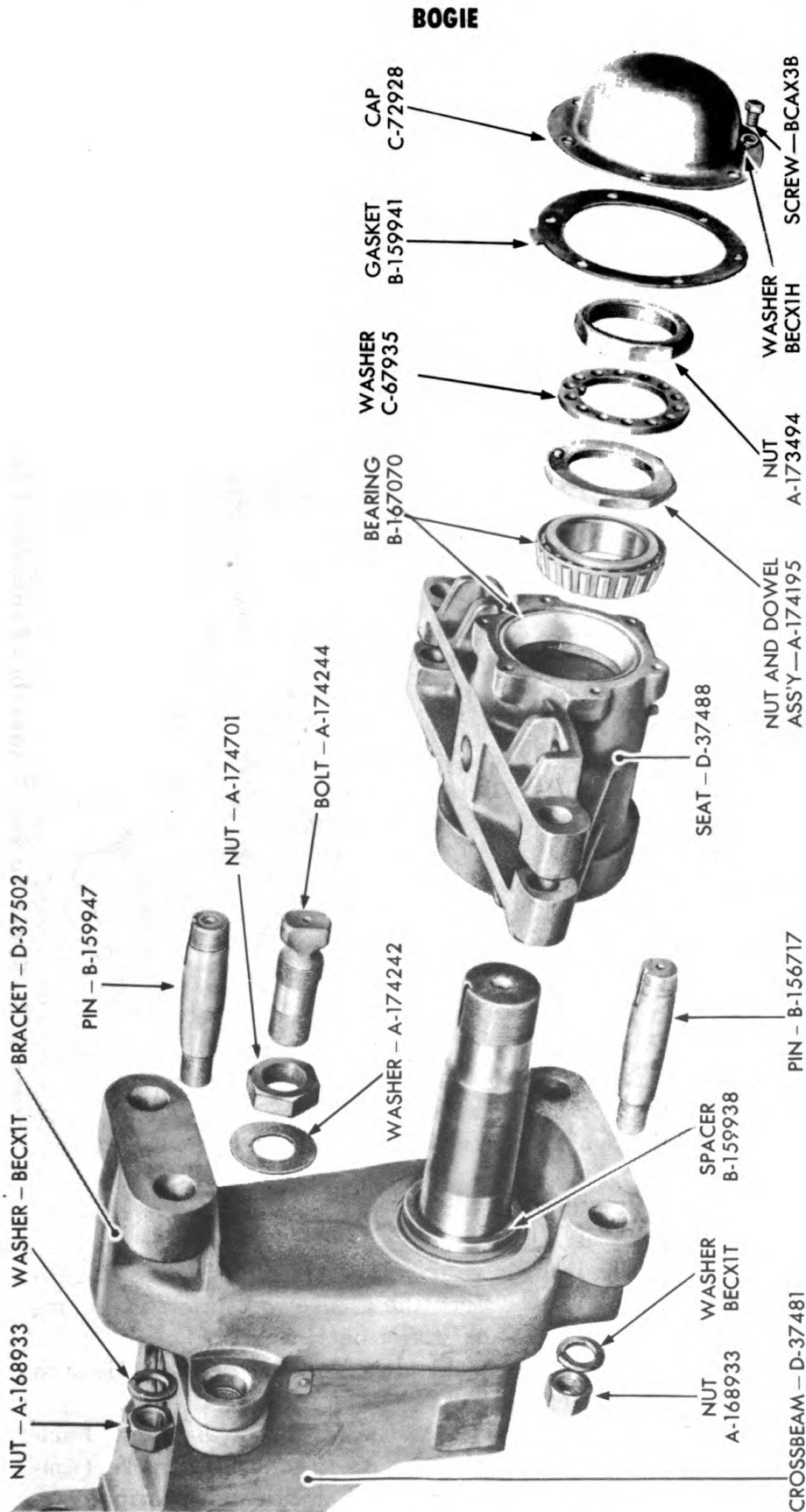
(1) Coat outside of outer roller bearing cup with **TALLOW**, mutton, refined, or **LEAD**, white. Press cup into place in bogie spring seat (fig. 272).

(2) Repeat procedure described in step (1) above and install inner roller bearing cup in spring seat.

(3) Pack inner roller bearing cone and roller with **GREASE**, general purpose (seasonal grade). Work the grease well into rollers. Insert cone and roller in place in inner roller bearing cup.

(4) Press oil retainer in place next to inner roller bearing. Be sure retainer sealing edge is next to bearing.

(5) Place bogie spring seat on crossbeam torque bracket. Pack outer bearing cone and roller with **GREASE**, general purpose (seasonal grade), as described in step (3) above, and install bearing.



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Figure 277 — Crossbeam and Bogie Spring Seat

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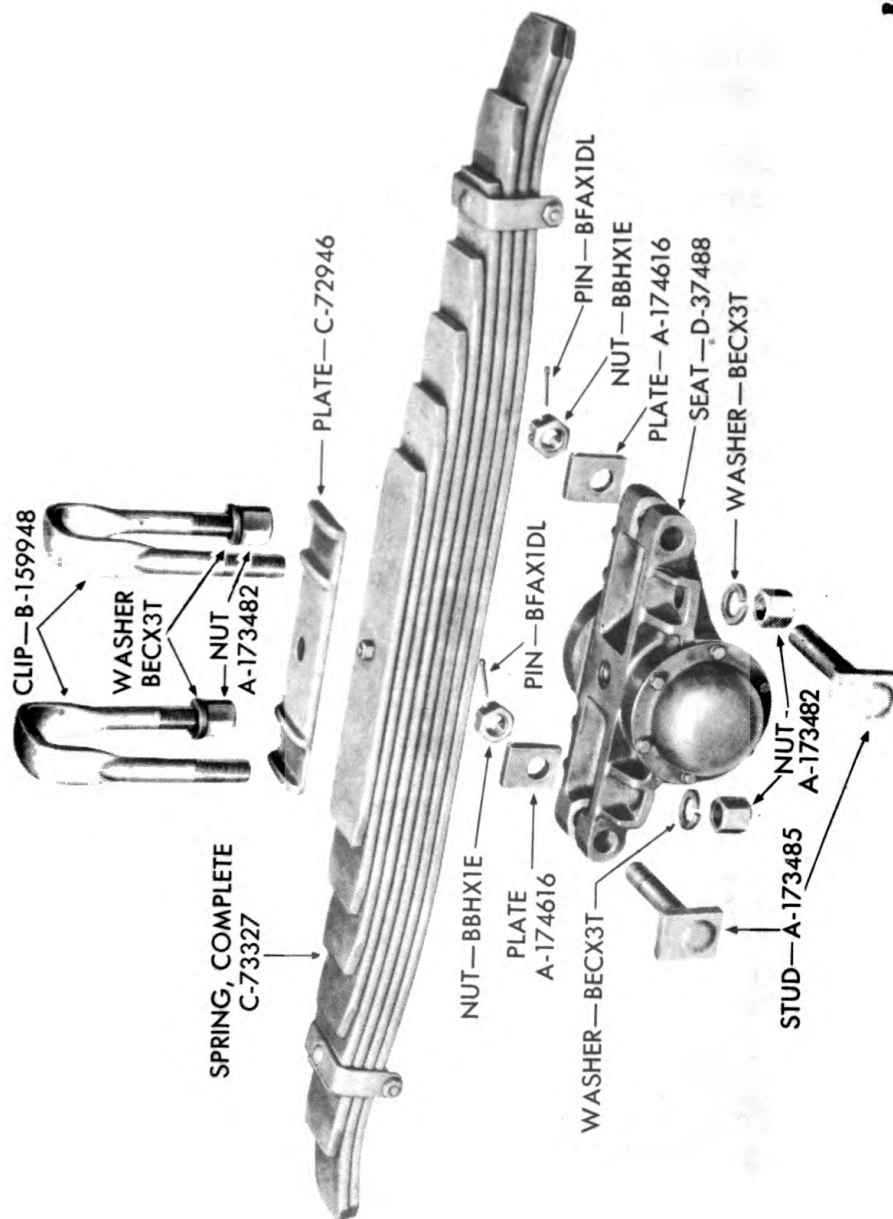


Figure 278—Bogie Spring Assembly—Exploded View

BOGIE

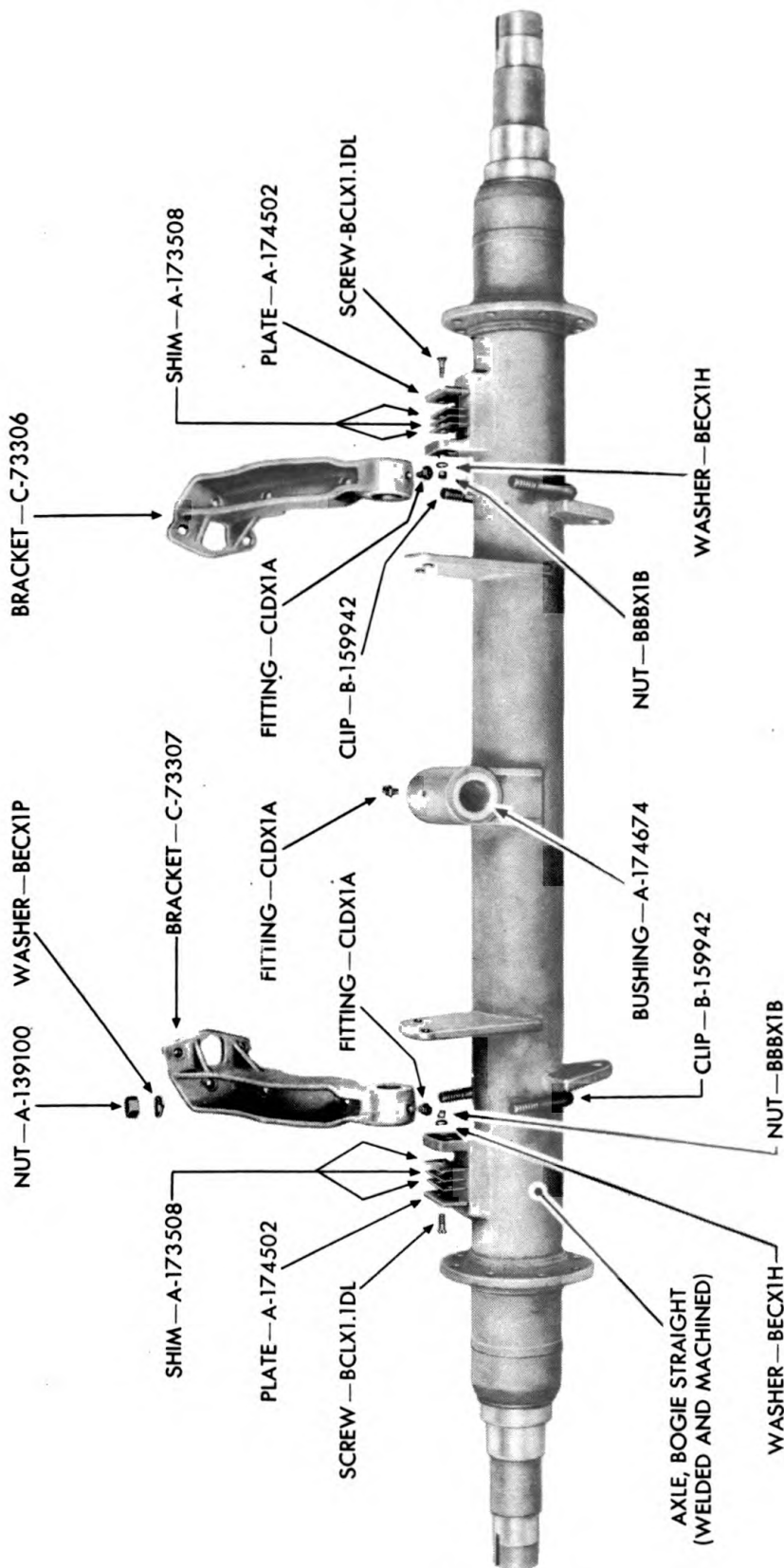
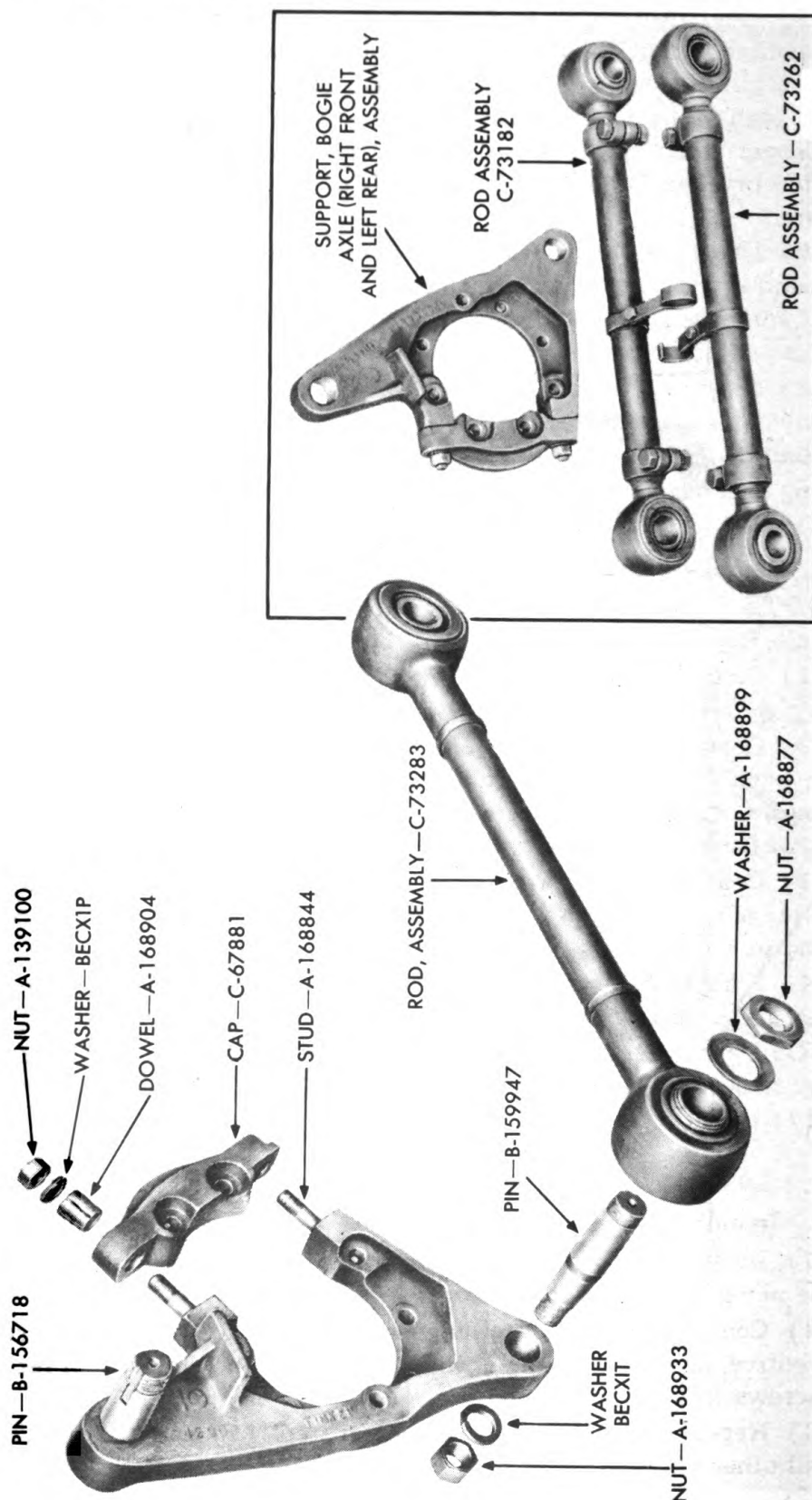


Figure 279 - Bogie Straight Axle and Parts

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



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Figure 280—Bogie Axle Support and Torque Rods

BOGIE

(6) Coat threads on end of crossbeam with COMPOUND, rust-preventive, light. Screw nut and dowel on crossbeam end, and tighten securely. Rock spring seat on bearings to determine fit. Spring seat must turn easily without binding, nor should there be any noticeable looseness when spring seat is pulled outward or pushed in toward torque bracket. Obtain proper fit by loosening or tightening nut and dowel.

(7) Place crossbeam spindle washer on crossbeam end, up against nut and dowel. Hole in washer must fit on dowel without disturbing fit of spring seat and bearings on crossbeam. If necessary, turn washer over to obtain alinement with dowel.

(8) Screw jam nut in place on crossbeam end. Tighten nut against crossbeam spindle washer (fig. 270).

(9) Shellac both faces of hub cap gasket. Install gasket and bogie spring seat hub cap, and secure with six screws and lock washers (fig. 269).

e. Install Bogie Springs.

NOTE: The following procedure covers the installation of one bogie spring. Repeat procedure to install the other spring.

(1) Place bogie spring in place on spring seat. Place bogie spring clip plate on top of spring (fig. 278).

(2) Coat threads of spring clips with COMPOUND, rust-preventive, light. Tap two spring clips down over bogie spring clip plate, springs, and through spring seat. Secure clips in place with nuts and lock washers.

(3) Coat threads of two bogie spring seat studs with COMPOUND, rust-preventive, light, and, from the outside, insert studs in place in spring seat.

(4) Place bogie spring seat stud plates on studs. Screw nuts on studs, and secure with cotter pins.

NOTE: In order to prevent injury to the bronze bogie lifting screws, they are not installed in the bogie until the bogie is completely assembled (par. 106).

101. ASSEMBLE BOGIE STRAIGHT AXLE.

a. Install Spring Guide Plate.

(1) Install same number of shims as removed, then install spring guide plate in place on top of bogie straight axle (fig. 279).

(2) Coat threads of retaining screws with COMPOUND, rust-preventive, light, and secure spring guide plate and shims with retaining screws, lock washers, and nuts.

(3) Repeat procedure as described in steps (1) and (2) above to install other plate and shims.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2****b. Install Brake Operating Cam Bracket.**

NOTE: The clips which hold brake operating cam brackets are welded to straight axle (fig. 279). Brake operating cam brackets are fitted with nonreplaceable babbit bushings. Left front and right rear brake operating cam brackets are interchangeable, as are the right front and left rear brackets.

(1) Coat threads of bracket clips with COMPOUND, rust-preventive, light, and install the two brackets in place on straight axle.

(2) Secure brackets with nuts and lock washers (figs. 261 and 279).

c. Install Bogie Axle Support.

NOTE: Left front and right rear bogie axle supports are interchangeable; right front and left rear axle supports are also interchangeable. The following procedure covers installation of one bogie axle support. Repeat procedure to install the other support.

(1) Press torque rod upper and lower pins in place in support. Do not lubricate pins (fig. 280).

(2) Coat threads on outside end of lower torque rod pin with COMPOUND, rust-preventive, light. Place lock washer and nut on pin.

(3) Place bogie axle support in position on bogie straight axle. Place axle support cap dowel on each support stud.

(4) Coat threads of studs with COMPOUND, rust-preventive, light. Secure axle support cap in place on studs and dowels with nuts and lock washers (fig. 260).

d. Install Wheel Brake Assembly (fig. 281).

(1) Wheel brake mechanism is disassembled, repaired, and assembled in paragraphs 109, 110, and 111.

(2) Left rear and right front wheel brake assemblies are interchangeable, as are the right rear and left front assemblies. The following procedure covers installation of one wheel brake mechanism. Repeat procedure to install the other wheel brake assembly on the bogie straight axle.

(a) Tap wheel brake assembly in position on bogie straight axle. Swing upper brake shoe assembly up and back out of the way (figs. 259 and 281).

(b) Coat threads of eight brake retaining bolts with COMPOUND, rust-preventive, light. Line up bolt holes in shield, axle flange, and axle support so cam hole in (shield) brake cam bracket B143501 lines up with cam hole in brake operating cam bracket on axle (figs. 305 and 281). Insert bolts through shield, axle flange, and axle support. There are three different lengths of these bolts. Be sure to get them in their proper places. Secure brake assembly to axle flange with lock washers and nuts.

e. Install Brake Operating Cam.

(1) Place brake operating cam washer A173496 on cam, and insert

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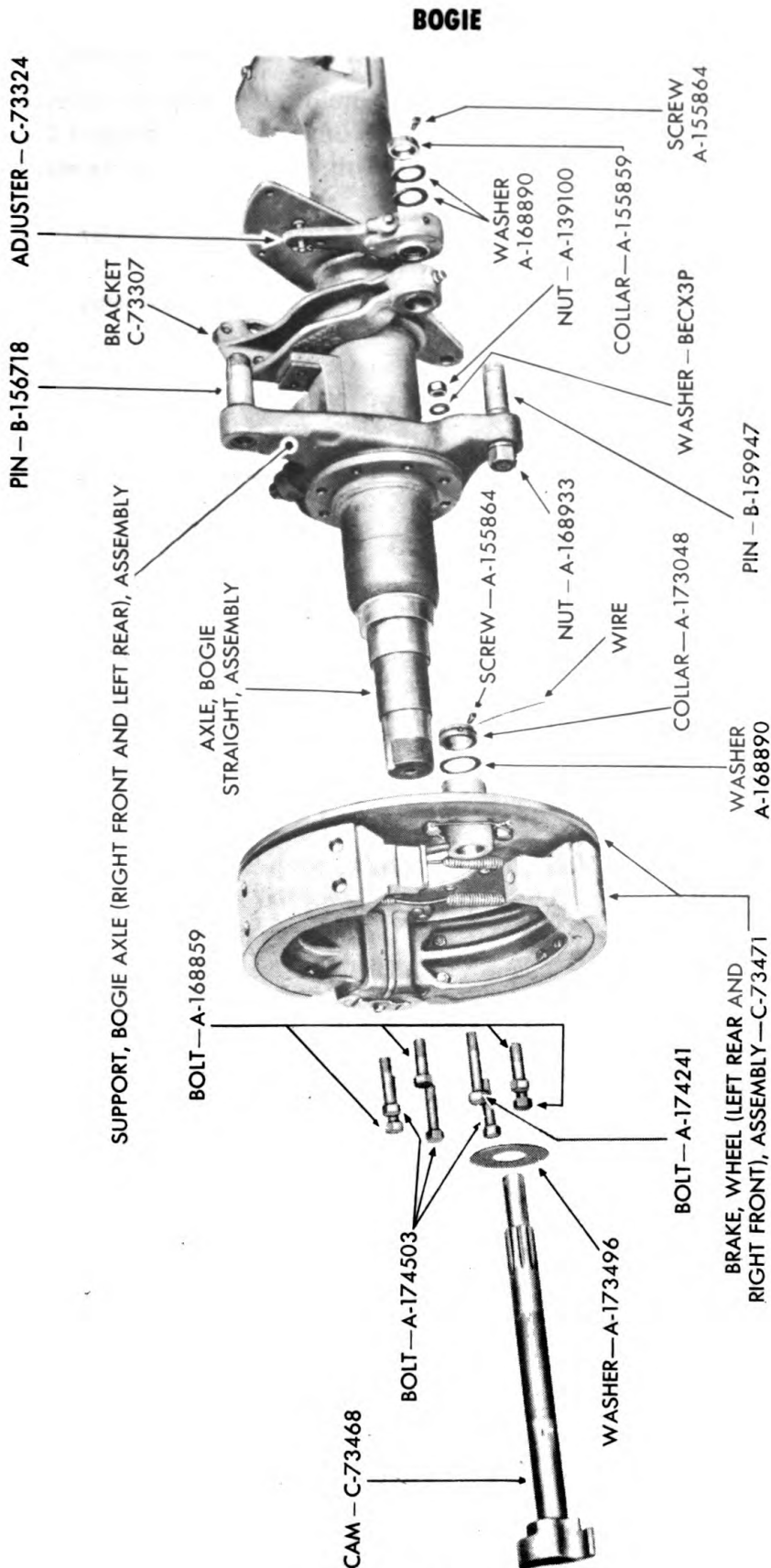


Figure 281 - Wheel Brake Parts - Exploded View

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

cam just far enough through bracket on shield to slide brake operating cam washer A168890 and collar A173048 on cam (figs. 258 and 281).

(2) Tap cam all the way into position through brake operating cam bracket on straight axle.

(3) Install washer and collar in place. Secure with screw and safety wire.

(4) Swing upper and lower brake shoes into position, and install the two brake shoe springs (fig. 257).

(5) Repeat procedure as described in steps (1), (2), (3), and (4) above to install brake operating cam on other side of bogie straight axle.

f. Install Wheel Hub and Brake Drum Assemblies (fig. 256) (par. 72, TM 9-335 or par. 54 b, TM 9-350).

g. Install Dual Wheels (fig. 256) (par. 72, TM 9-335 or par. 54 b, TM 9-350).

h. Install Lower Front Torque Rods (fig. 253).

(1) Drive the two lower front torque rods on torque rod end pins of axle support. Do not lubricate rods or pins.

(2) Secure rods in place with washers and nuts. Bend washers down over flats of nuts.

102. INSTALL BOGIE STRAIGHT AXLE.

a. Connect Bogie Straight Axle to Crossbeam.

(1) Wheel bogie straight axle into position so it can be connected to bogie crossbeam (fig. 255).

(2) Drive torque rod end pins (installed in rear end of lower torque rods) in position in crossbeam torque bracket (fig. 253). Secure rods in place with torque rod end pin washers and nuts.

b. Install Upper Front Torque Rods.

NOTE: Left front and right rear upper torque rods are interchangeable. Torque rods measure 23½ inches from center to center of ends. This measurement is not adjustable.

(1) Drive torque rod into position in axle support and crossbeam torque brackets (fig. 253). Do not lubricate pins.

(2) Secure front end of torque rod to axle support with dished washer and nut. Bend washer down over flat of nut. Secure rear end of torque rod to crossbeam bracket with lock washer and nut.

(3) Repeat procedure as described in steps (1) and (2) above to install the other torque rod.

c. Install Wheel Supporting Cables (figs. 252 and 282).

(1) Hook the eye end of the wheel supporting cable on torque rod hook.

(2) Place adjustable rod end yoke of cable in position, and secure to bogie straight axle bracket with rod end pin and cotter pin.

BOGIE

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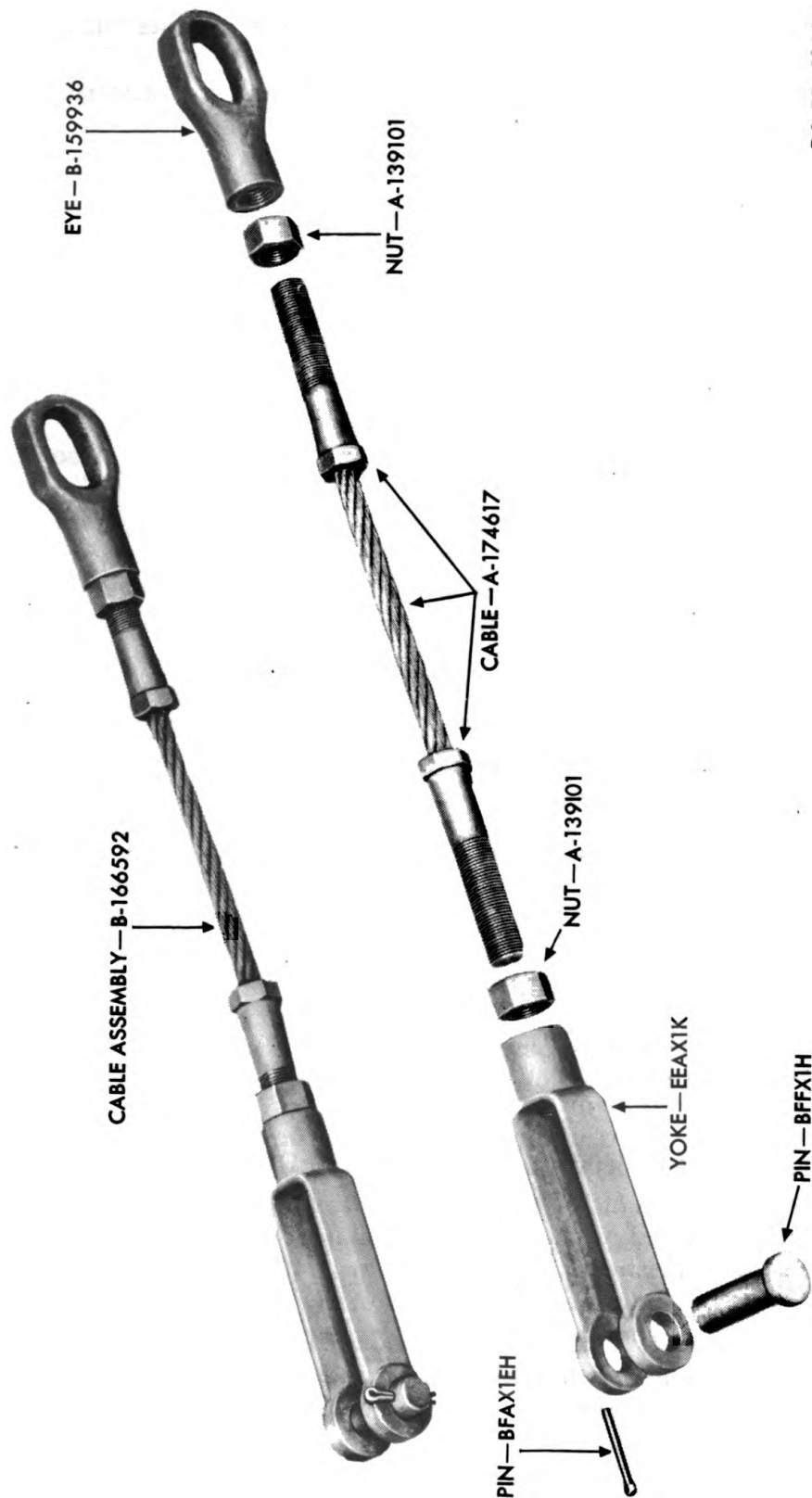


Figure 282 - Wheel Supporting Cable

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

(3) The other front wheel supporting cable is installed in the same manner.

(4) The two rear wheel supporting cables are not installed until bogie arch axle is connected to bogie crossbeam.

d. Install Front Air Brake Diaphragms.

NOTE: The right front and left rear brake diaphragms are interchangeable, as are the left front and right rear diaphragms.

(1) Coat the threads of screws with COMPOUND, rust-preventive, light. Place diaphragm in position and secure with three screws, washers, and nuts (fig. 252). The short screw goes in bottom hole.

(2) Repeat procedure described above to install the other brake diaphragm on bogie straight axle.

e. Install Slack Adjuster and Hand Brake Lever Assembly (figs. 250 and 251).

(1) Place slack adjuster in position on brake operating cam.

(2) Slide hand brake lever assembly on brake operating cam.

(3) Loosen slack adjuster set screw and turn slack adjuster worm to rotate slack adjuster far enough forward to permit hand brake lever assembly to go all the way into position.

(4) Rest lug on hand brake lever against back of slack adjuster.

(5) Push hand brake lever back and rotate slack adjuster again as in step (3), above. Connect diaphragm push rod yoke to slack adjuster with rod end pin and cotter pin. Tighten set screw in slack adjuster.

(6) Place the two washers and brake operating cam collar on brake operating cam. Secure collar in place with screw and safety wire.

(7) Drive the two latch plate studs in the hand brake lever latch plate. Coat threads of studs with COMPOUND, rust-preventive, light. Place hand brake lever latch plate assembly in position, and secure to bogie straight axle with nuts and cotter pins.

(8) Repeat procedure described above to install the other slack adjuster and hand brake lever assembly on bogie straight axle.

103. ASSEMBLE AND MOUNT PINTLE AND LATCH ASSEMBLY.

a. Assemble Pintle and Latch Assembly (fig. 249).

(1) Install pintle lock in pintle, and drive pintle lock bolt through pintle and pintle lock.

(2) Coat threads of pintle bolt with COMPOUND, rust-preventive, light. Screw nut on bolt and secure with cotter pin.

(3) Clamp pintle latch in a vise. Tap pintle latch spring in place in the latch.

(4) Place pintle latch in position on pintle lock. Insert pintle latch pin. Secure pin with screw and lock washer.

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BOGIE

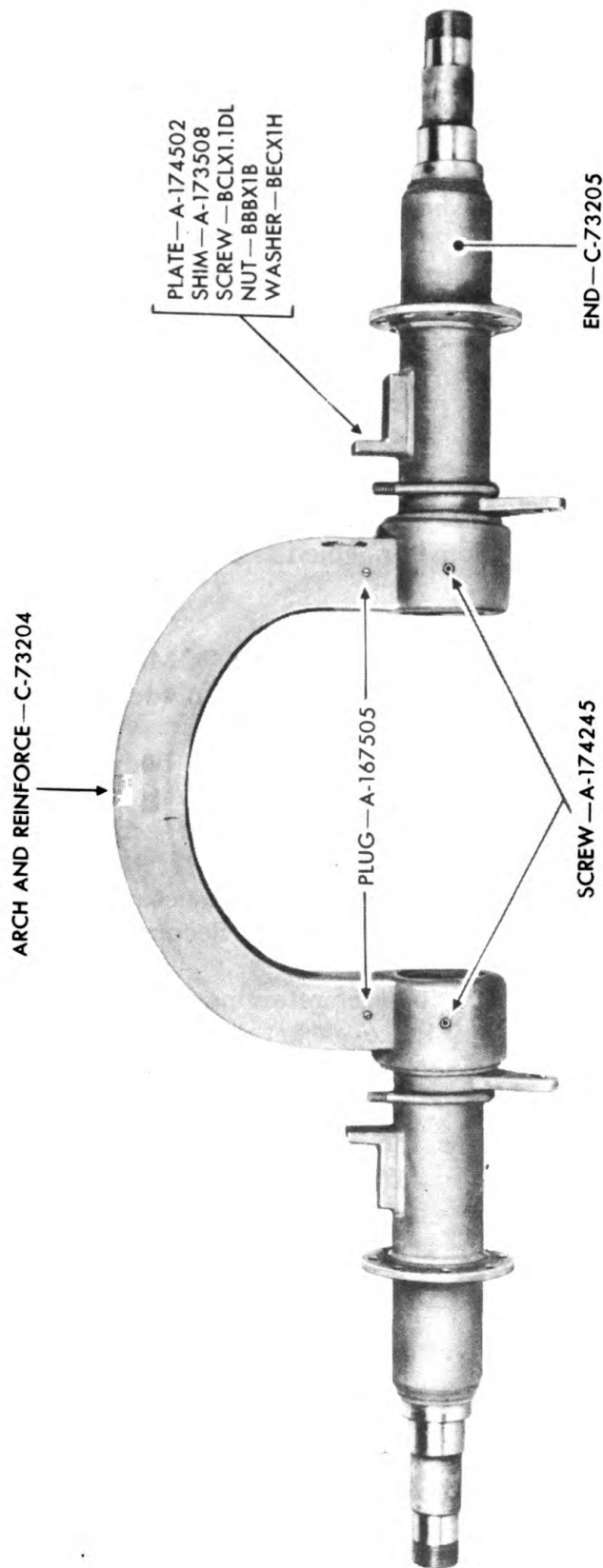


Figure 283 — Bogie Arch Axle

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

b. Install Pintle and Latch Assembly.

(1) Coat pintle shaft with **GREASE**, general purpose (seasonal grade). Tap pintle and latch assembly in place in bushings in bogie straight axle.

(2) Coat pintle shaft threads with **COMPOUND**, rust-preventive, light. Place plain washer on shaft, and screw nut on pintle shaft. Secure nut with cotter pin (fig. 248).

NOTE: Attach the extra cotter pin with wire. This cotter pin is used to hold the pintle to pintle latch when materiel is towed by prime mover.

104. ASSEMBLE AND INSTALL BOGIE ARCH AXLE (figs. 267, 265, and 283).

NOTE: The procedure for assembling the bogie arch axle (fig. 283) is the same as the procedure for assembly of the bogie straight axle (par. 101), except for the odometer which is installed in right rear hub cap.

a. Assemble Odometer (fig. 265).

(1) Coat threads of odometer pin with **COMPOUND**, rust-preventive, light. Screw odometer pin into place in end of bogie arch axle on the right side.

(2) Coat inside of odometer cover and odometer body with a light film of **GREASE**, general purpose, No. 2 (fig. 267).

(3) Place odometer lever on odometer cover, and secure in position with clamp screw and lock washer (fig. 266).

(4) Install odometer drive gear in place in odometer body. Install odometer cover in position in odometer body. Secure in place with spring wire.

(5) Coat the threads of six odometer retaining screws with **COMPOUND**, rust-preventive, light. Place gasket and odometer in position, and secure to hub with six screws and lock washers.

b. Install Bogie Arch Axle. The procedure for installing the bogie arch axle is the same as the procedure for installing bogie straight axle, except that hand brake lever assemblies are not installed (par. 102).

105. ASSEMBLE AND INSTALL CRADLE LOCK ASSEMBLY.

a. Assemble Cradle Lock (figs. 241, 246, and 247).

(1) Place cradle lock frame in a vise. Insert Woodruff key in slot in cradle lock screw, and tap screw and key part way into cradle lock frame.

(2) Coat threads of screw with **COMPOUND**, rust-preventive, light. Slide upper lock washer on screw, then install upper nut. Follow with lower nut and lower lock washer.

(3) Adjust nuts until the distance between cradle lock pin hole in

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BOGIE

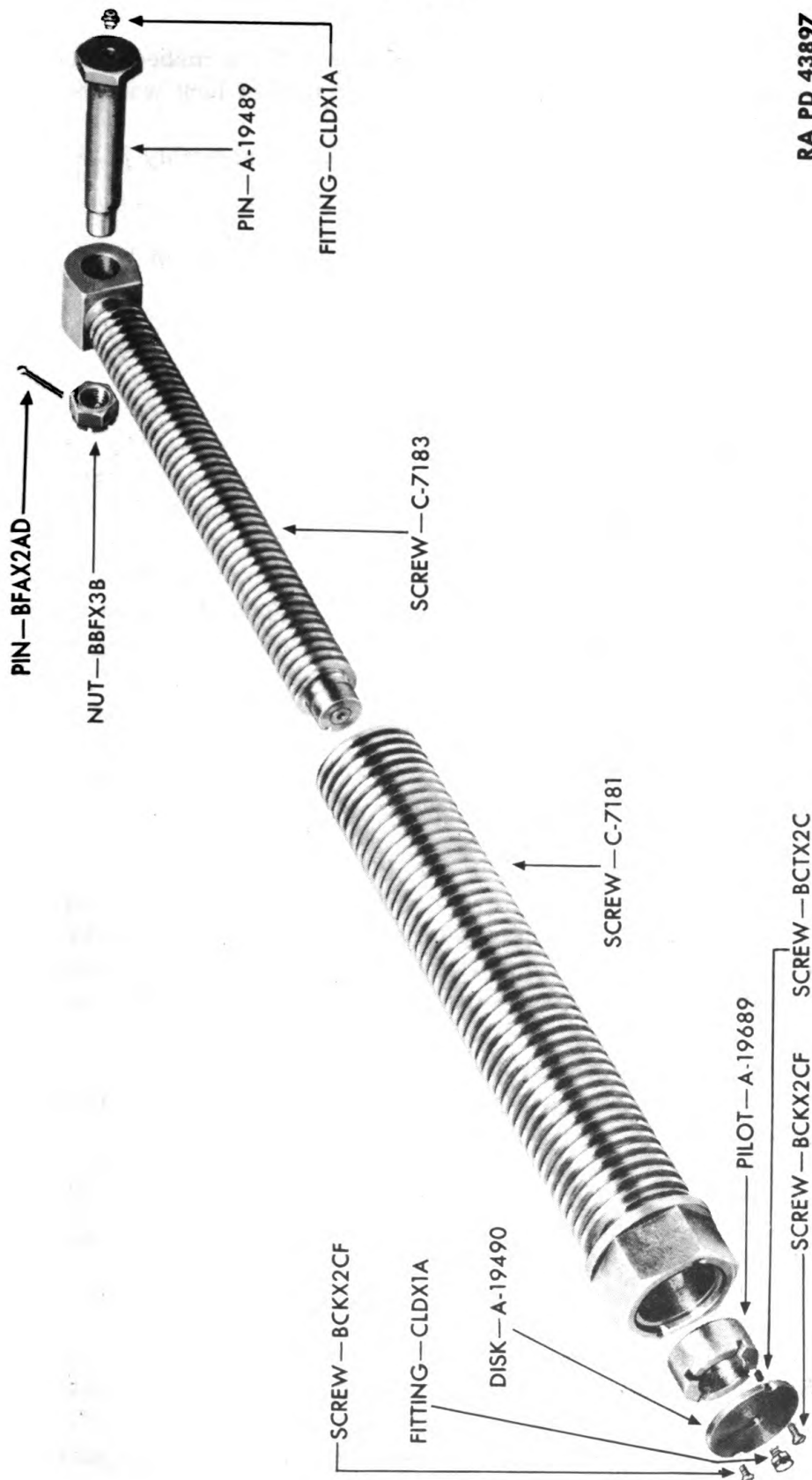


Figure 284—Bogie Lifting Screw Parts

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

screw and rod end hole in frame, measures 17.70 inches (fig. 247). Then tighten upper and lower nuts. Bend tabs of lock washers down over nuts.

(4) Install cradle lock pin and attach chain assembly SDAX5GB to cradle lock frame and cradle lock pin.

b. Install Cradle Lock Assembly.

(1) Place cradle lock assembly in position on top of bogie cross-beam, with the chain on the left side (fig. 243).

(2) Insert two rod end pins, with heads of rod end pins inside. Secure with cotter pins.

106. INSTALL BOGIE LIFTING SCREWS.**a. Install Outer and Inner Bogie Lifting Screws (fig. 284).**

(1) Coat threads of outer lifting screws and threads in bogie cross-beam with GREASE, general purpose (seasonal grade). Install outer screws in place in top of crossbeam.

(2) Coat threads of inner lifting screws and mating threads inside outer lifting screws with GREASE, general purpose (seasonal grade). The inner screws will have to be installed from the bottom. It will be necessary to raise front end of bogie and block it up so it cannot tip or fall, in order to insert the inner screws (fig. 245).

(3) Position inner and outer screws so that exactly 14 threads of the inner lifting screws are below the bottom of outer lifting screws, and exactly 16 threads of outer screws are below the bottom face of the crossbeam. Lower bogie.

b. Install Bogie Lifting Screw Pilots.

(1) Screw bogie lifting screw pilot in place on top end of each inner screw, using bogie lifting screw pilot wrench B105445 and a steel bar.

(2) Line up set screw threads in pilot and inner screw, and secure pilot to inner screw with set screw. Stake set screw in two places (fig. 244).

c. Install Bogie Lifting Screw Disk.

(1) Place lifting screw disks in position on top of outer lifting screws (fig. 243).

(2) Secure disks to outer screws with two machine screws in each outer screw.

d. Procedure for mounting bogie on carriage is covered in paragraph 115.

Section XXI

BRAKE MECHANISM

	Paragraph
General	107
Malfunctions	108
Disassemble brake mechanism	109
Maintenance and repair of brake mechanism	110
Assemble brake mechanism	111

107. GENERAL.

a. Complete description of the brake mechanism is contained in paragraph 18, TM 9-335 and paragraph 18, TM 9-350. Brake operation is covered in paragraph 32, TM 9-335 and paragraph 25, TM 9-350.

b. The procedure described in this section pertains to the disassembly, maintenance and repair, and assembly of the various subassemblies which comprise the wheel and brake mechanism, after they have been removed from the howitzer (or gun) carriage.

c. The brake mechanism is removed and installed in paragraphs 94 and 101.

108. MALFUNCTIONS.

a. Malfunctions of the brake mechanism are covered as in paragraph 56, TM 9-335 and paragraph 41 n, o, p, q, r, and s, TM 9-350.

109. DISASSEMBLE BRAKE MECHANISM.

a. **Disassemble Relay-emergency Valve** (figs. 285 and 286).

(1) Place relay-emergency valve C73678 in a vise fitted with copper jaws. Unscrew and remove exhaust fitting assembly A194872.

(2) **DISASSEMBLE RELAY PORTION OF RELAY-EMERGENCY VALVE.**

(a) Unscrew the relay valve cover from the relay valve body and remove the gasket, the retainer, and the spring (figs. 286 and 287). Then pull out the diaphragm and guide group. Disassemble the diaphragm and guide group by removing the cotter pin, retaining nut, washer, diaphragm, and guide ring.

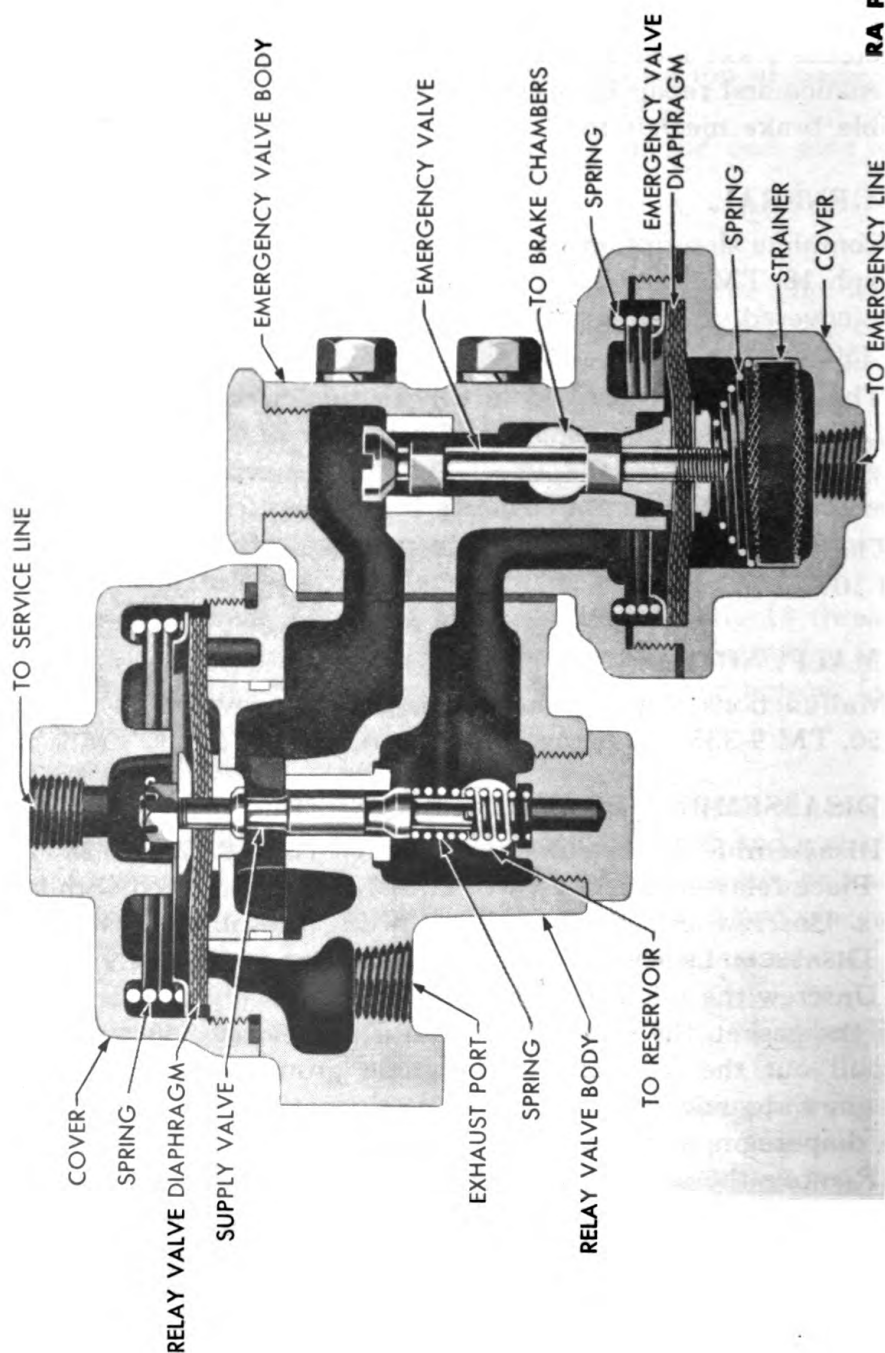
(b) Remove the supply valve spring retaining nut by unscrewing it from the relay valve body, and remove the spring and the supply valve.

(3) **DISASSEMBLE EMERGENCY PORTION OF RELAY-EMERGENCY VALVE.**

(a) Unscrew the body cover from the emergency valve body, and remove the gasket, strainer, and strainer spring (figs. 286 and 288).

(b) Unscrew the retaining nut from the diaphragm. Unscrew the

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 37419

Figure 285—Relay-emergency Valve—Sectional View

BRAKE MECHANISM

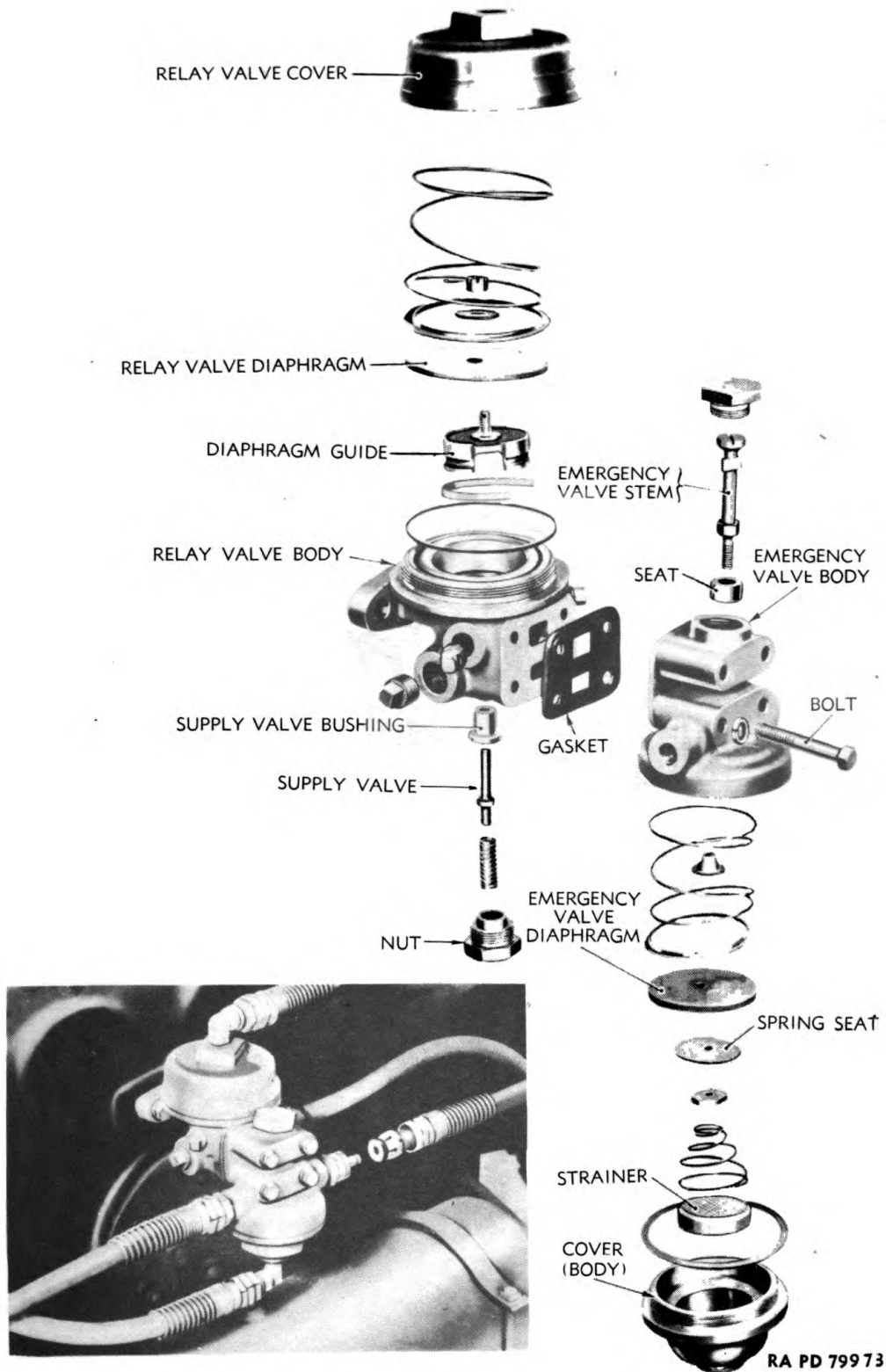
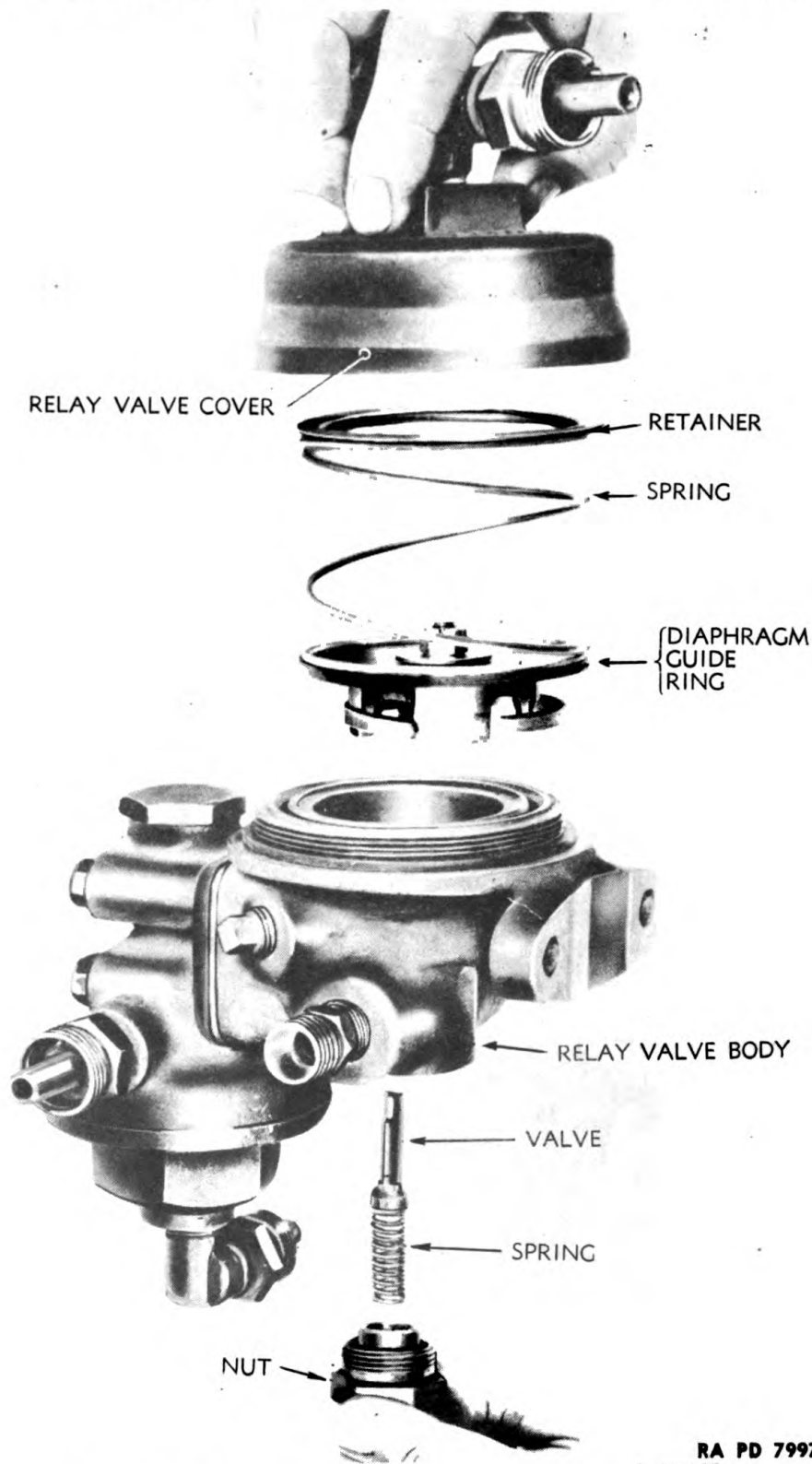


Figure 286—Relay-emergency Valve—Exploded View

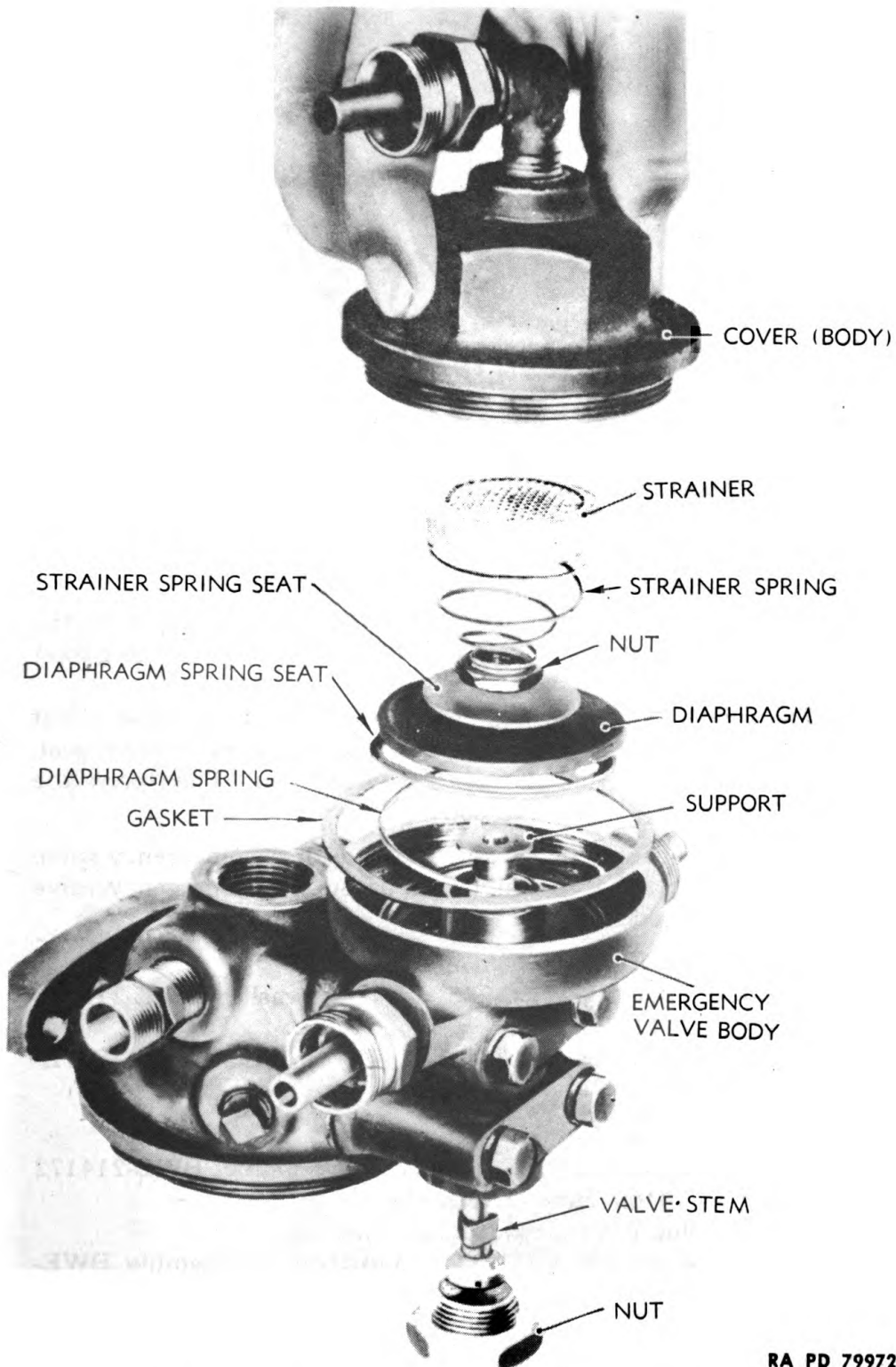
ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 79971

Figure 287—Relay-emergency Valve—Relay Portion

BRAKE MECHANISM



RA PD 79972

Figure 288—Relay-emergency Valve—Emergency Portion

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

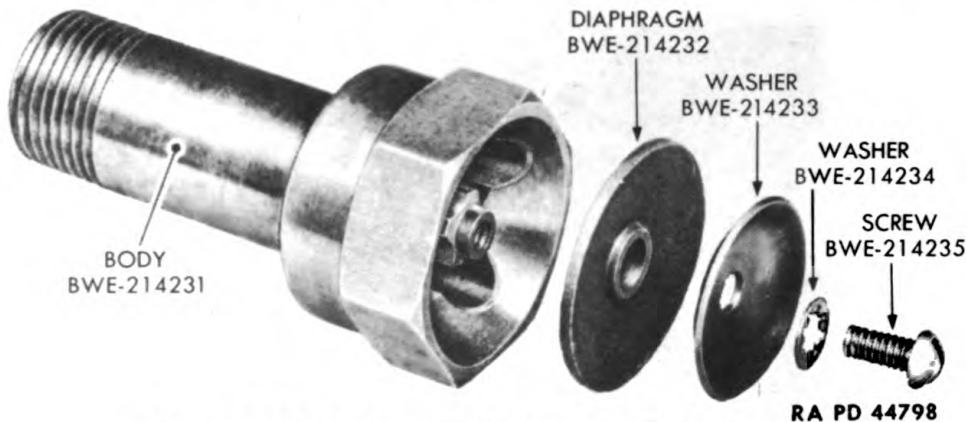


Figure 289—Exhaust Fitting—Exploded View

retaining nut from the emergency valve body. Then remove the strainer spring seat, diaphragm, diaphragm spring seat, diaphragm spring, and support. Next pull the emergency valve stem out of position.

(4) DISASSEMBLE EMERGENCY VALVE BODY AND RELAY VALVE BODY.

(a) Remove the four retaining bolts and washers, separate the emergency valve body and relay valve body, and remove the gasket (fig. 286). Remove pipe plugs.

(b) The supply valve bushing can be removed by pressing it out toward the flanged end. To remove the emergency valve stem seat, thread it internally and install a plug or equivalent. Then press the seat out of the emergency valve body.

CAUTION: Make only two or three threads in the emergency valve stem seat. Do not thread it the full length because the emergency valve body will be damaged.

b. Disassembly Exhaust Fitting (fig. 289).

(1) Remove screw BWE-214235 and lock washer BWE-214234 from body BWE-214231.

(2) Lift diaphragm washer BWE-214233 and diaphragm BWE-214232 from body.

c. Disassemble Air Filter (fig. 290).

(1) Remove two screws BWE-210897 from chamber BWE-214172 and body BWE-214169. Remove chamber.

(2) Remove plug BWE-213530 from chamber.

(3) Remove support BWE-214171 and strainer assembly BWE-221053 from body. Remove gasket BWE-214173 from body.

(4) Remove two screws BWE-204046 from flange BWE-214134. Lift flange and gasket BWE-214174 from body.

(5) Repeat procedure as described in step (4) above to remove the other flange and gasket.

BRAKE MECHANISM

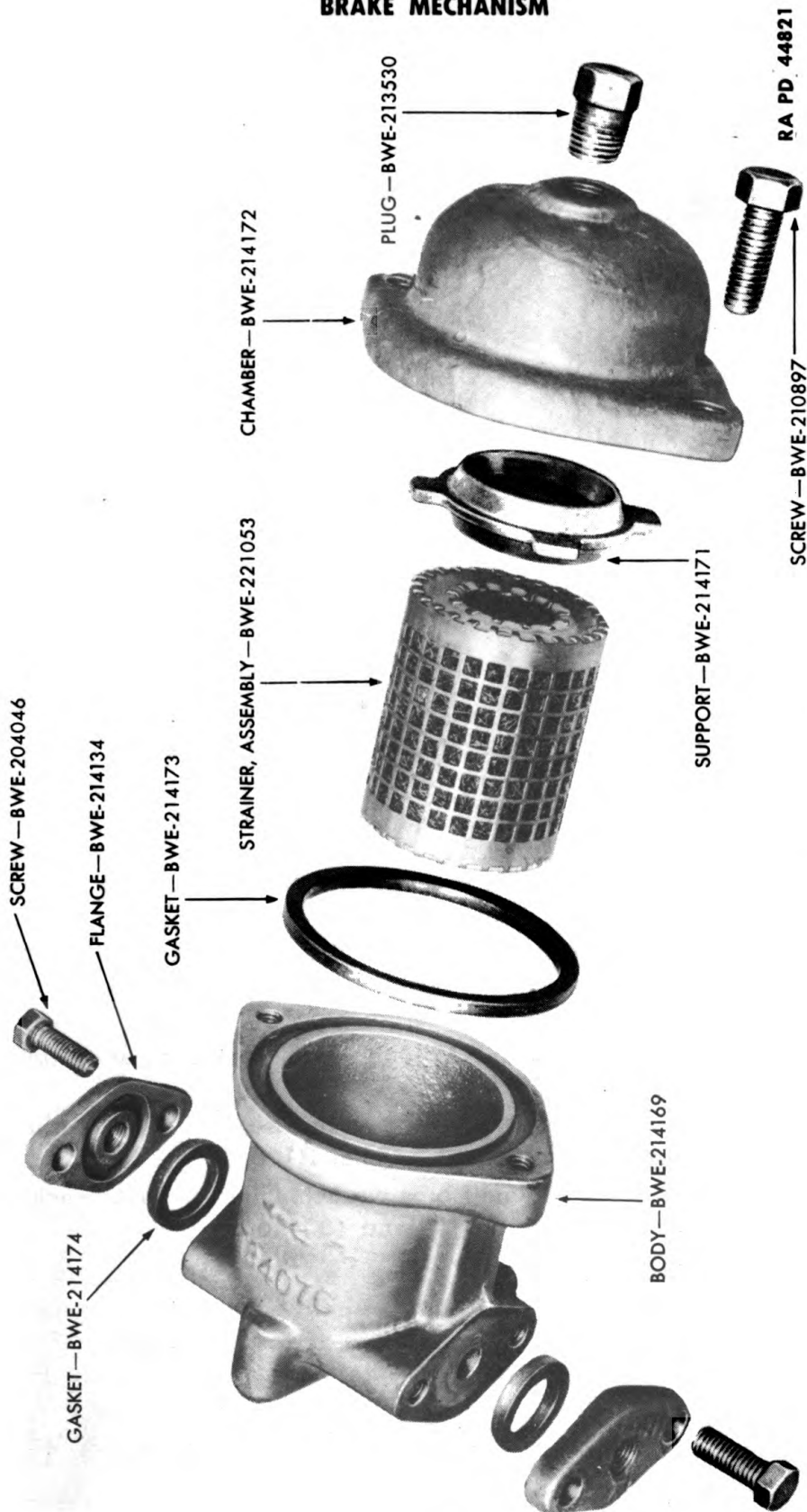


Figure 290 — Air Filter — Exploded View

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

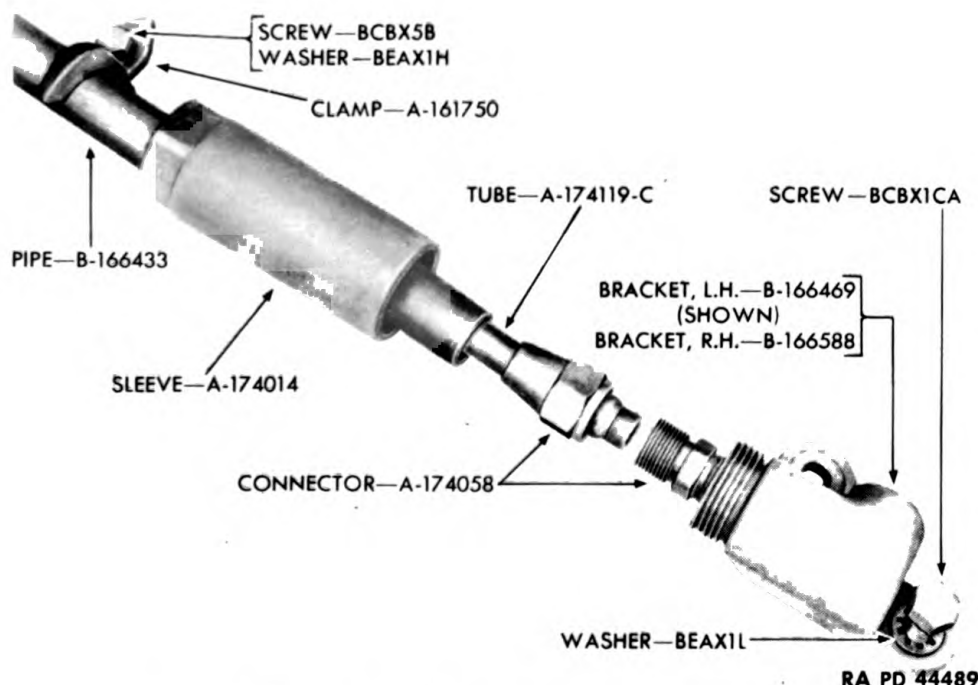


Figure 291—Pipe and Clamp Group—Front End

d. Disassemble Pipe and Clamp Group (figs. 291 and 292).

(1) Place front end of pipe and clamp assembly in a vise fitted with copper jaws (fig. 293). Unscrew sleeve A174014 and slide it back on pipe B166433 to expose connector A174058 (fig. 294).

(2) Remove part of connector A144525A from bracket B166469 (fig. 293). The other part of connector remained in hose assembly A140643 when it was disconnected from pipe and clamp.

(3) Disconnect connector A174058 from bracket and tube A174119C (fig. 294).

(4) Place the other (rear) end of pipe in vise. Unscrew coupling B108582 from nipple A191007 and bracket B166432.

(5) Remove nipple with small pipe wrench. Then remove bracket from pipe and connector (steps (1) and (3) above).

e. Disassemble Coupling.

(1) Place coupling B108582 in a vise fitted with copper jaws (fig. 295). Remove four screws from plate and remove plate.

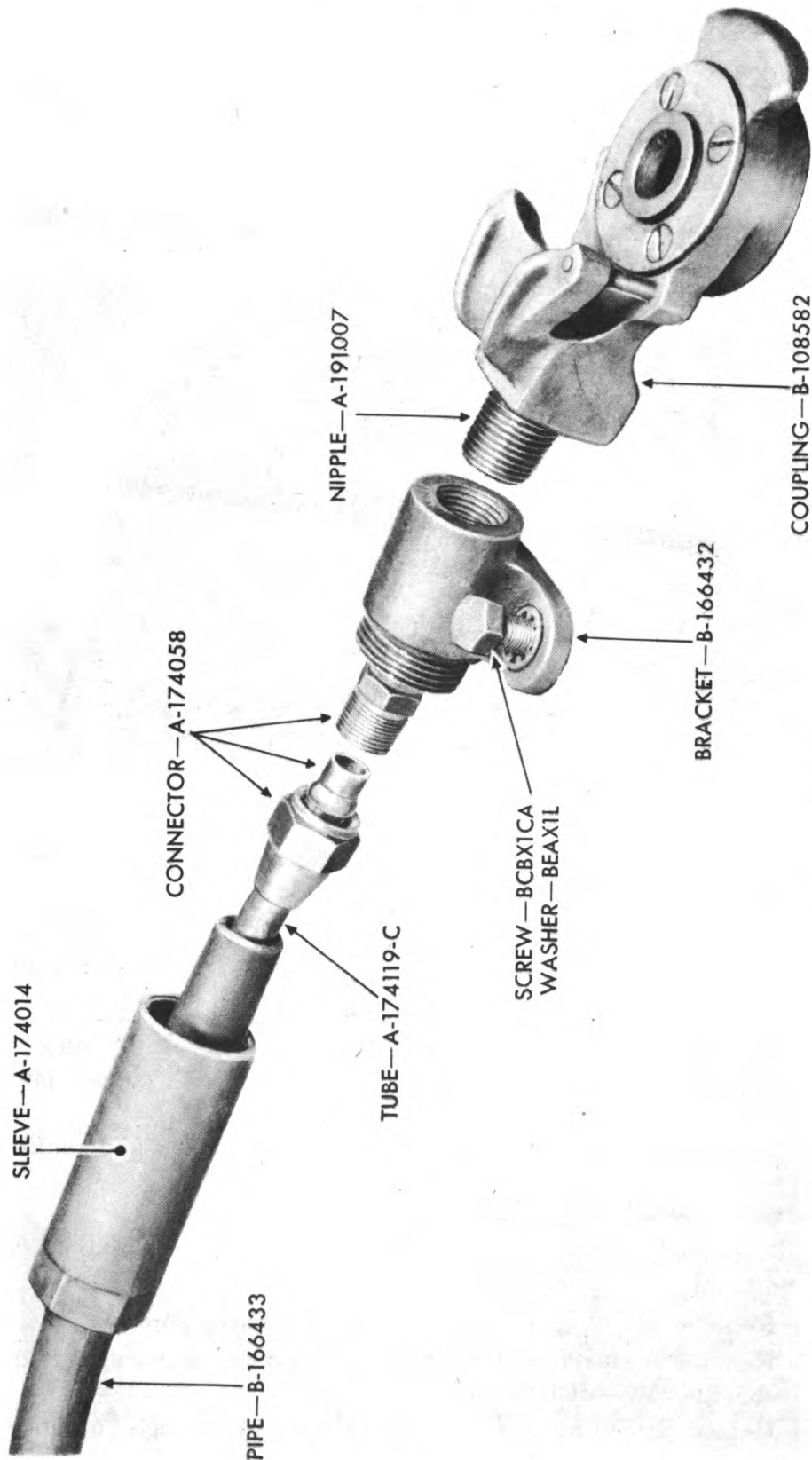
(2) Pull rubber washer from body of coupling.

f. Disassemble Hand Brake Lever (fig. 296).

(1) Remove four cotter pins BFAX1CC from pins A174501. Tap pins out and remove lever B105226.

(2) Unscrew connector A173503 from rod A173506.

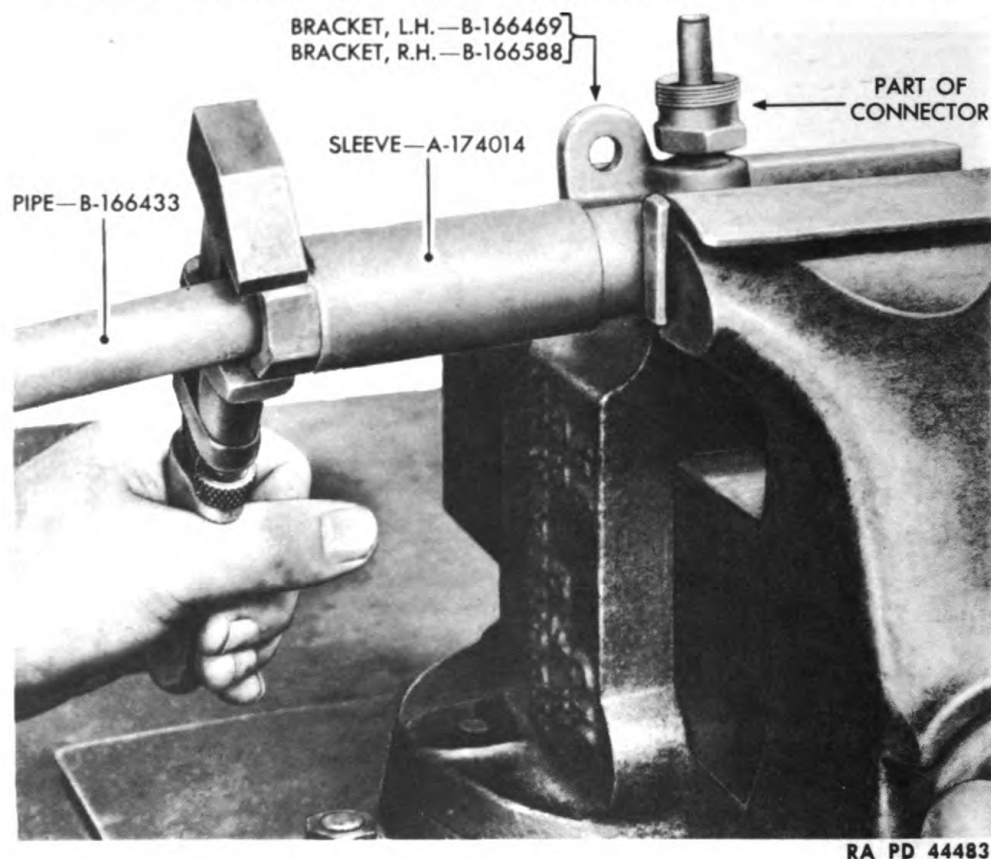
BRAKE MECHANISM



RA PD 44486

Figure 292—Pipe and Clamp Group—Rear End

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44483

Figure 293—Removing Sleeve

(3) Remove four cotter pins BFAX1CC from two pins A173500. Tap pins out of latch A173504 and rod A173506.

(4) Slide rod and spring A173502 out of lug on lever B159951.

(5) Repeat procedure as described in steps (1), (2), (3), and (4) above to disassemble other hand brake lever.

g. Disassemble Air Brake Diaphragm (figs. 297 and 298).

(1) Place air brake diaphragm in a vise fitted with copper jaws. Remove connector body BWE-215992.

(2) Unscrew and remove diaphragm push rod yoke, and remove nut from push rod.

(3) Pull boot off diaphragm body and push rod.

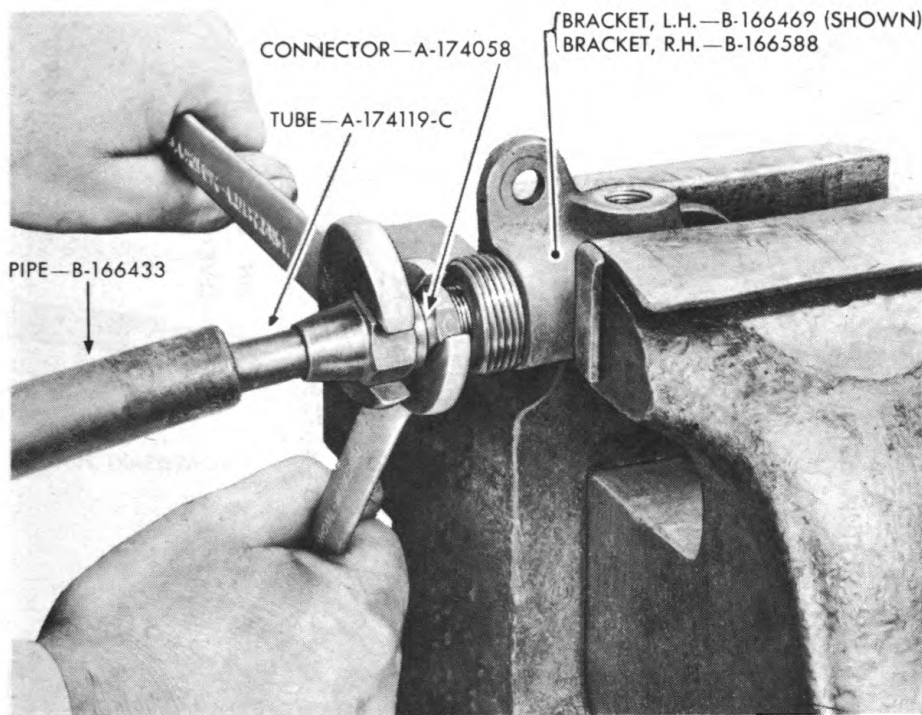
(4) Remove cap screws, nuts, and lock washers from diaphragm cover and body.

(5) Remove diaphragm cover and lift out diaphragm.

(6) Remove push rod and push rod spring from diaphragm body. Boot connector is welded to body.

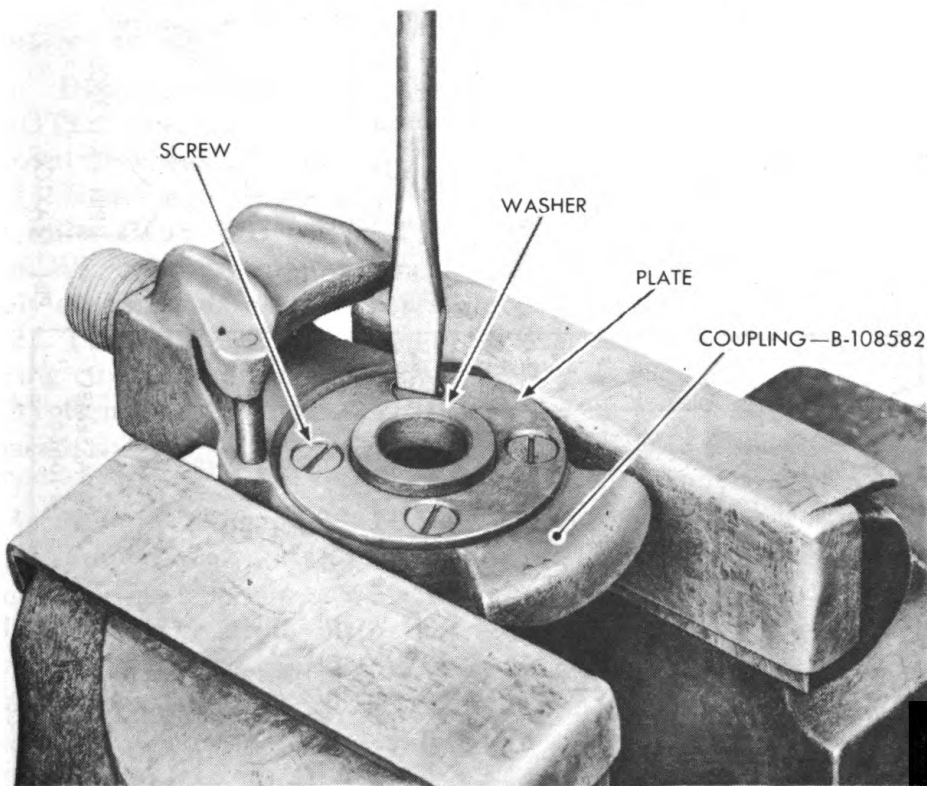
(7) Repeat procedure as described in steps (1) through (6) above to disassemble the other three brake diaphragm assemblies.

BRAKE MECHANISM



RA PD 44474

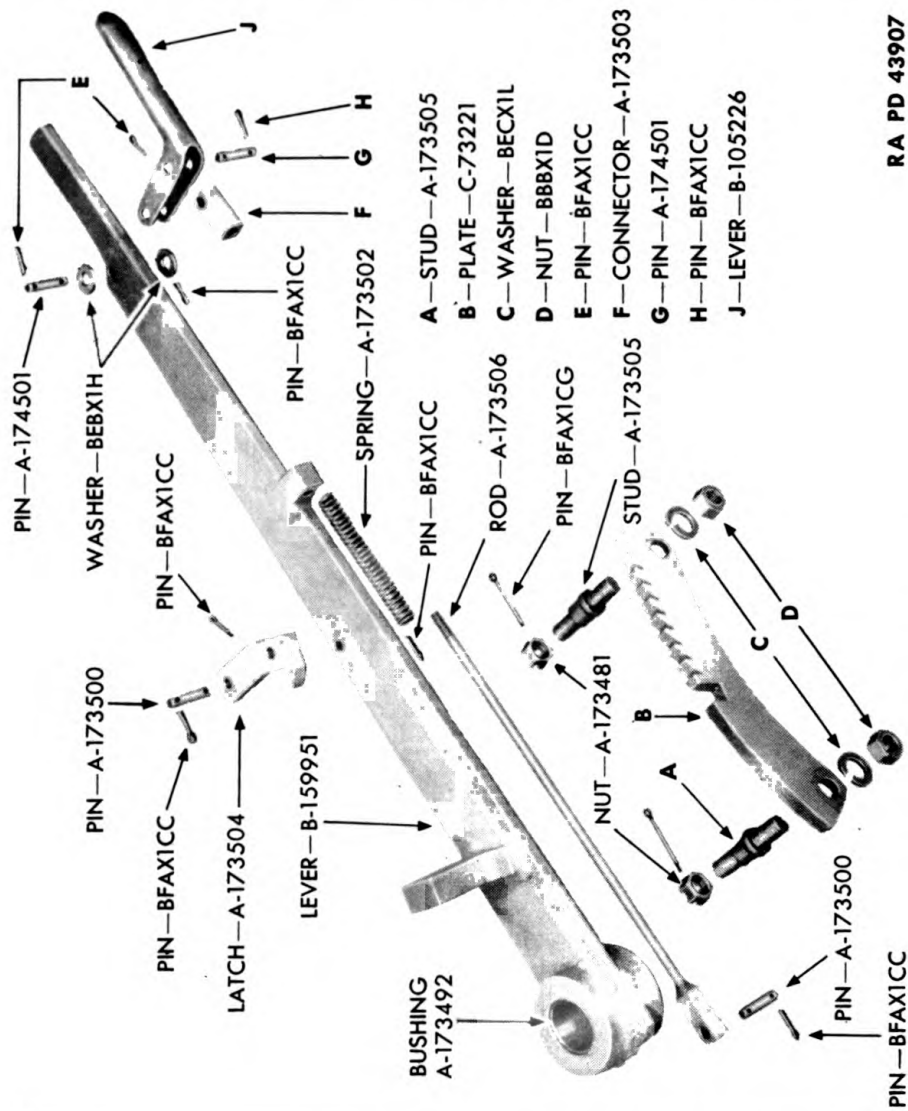
Figure 294—Removing Pipe and Tube



RA PD 44475

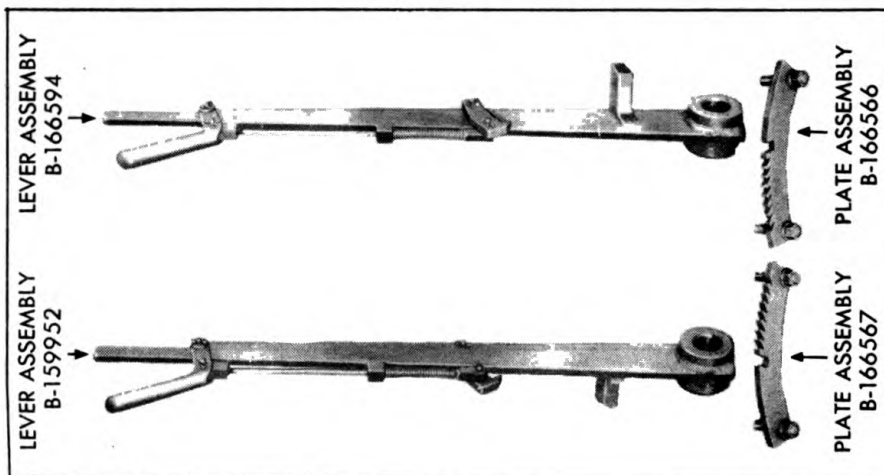
Figure 295—Removing Coupling Washer

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 43907

Figure 296—Hand Brake Lever and Related Parts



BRAKE MECHANISM

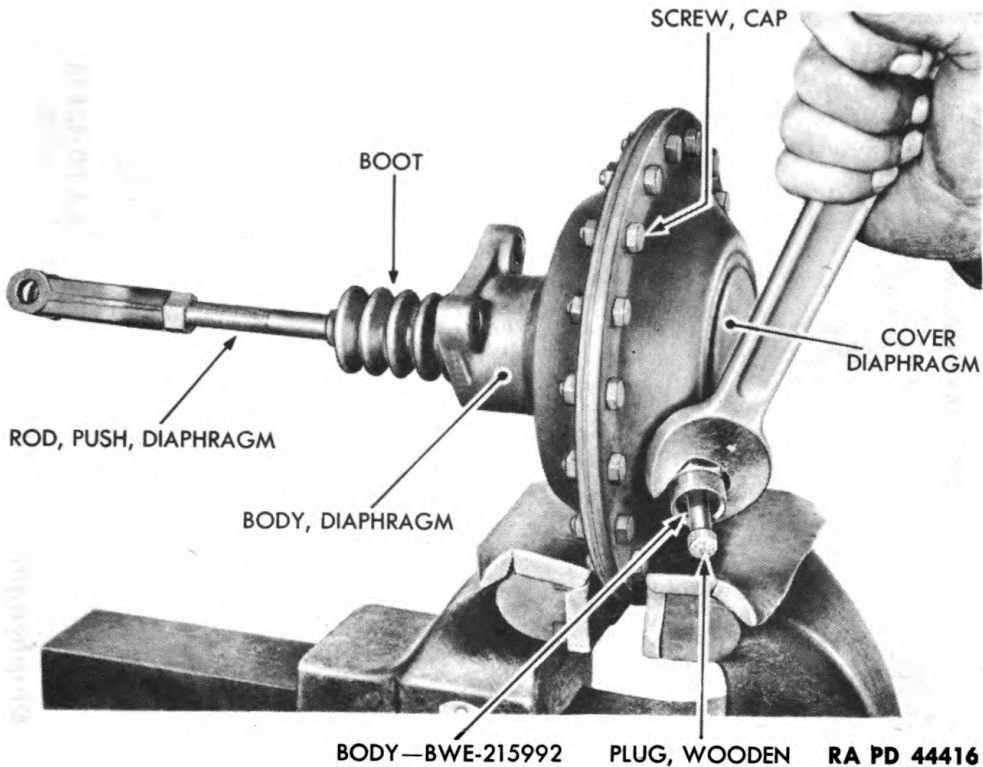


Figure 297—Removing Hose Connector Body

h. Disassemble Wheel Hub and Brake Drum.

NOTE: There are four notches in wheel hub D37426 to facilitate removal of wheel bearing cups.

(1) Remove retainer B166564, inner roller bearing B195776 (cone and roller B195776B and cup B195776A) from hub D37426 (fig. 256). When driving retainer and bearing out, be sure to strike alternately on each side of inner bearing cup.

(2) Turn hub and drum assembly over and remove outer roller bearing cup A174083 in same manner as above.

(3) Remove ten nuts A139101 from ten studs B166963 (fig. 299). Separate hub D37426 from drum and slinger assembly C73212 (fig. 300).

(4) Remove slinger C73211 from drum C73210.

(5) Tap ten disk and rim wheel studs out of hub from inner side of hub.

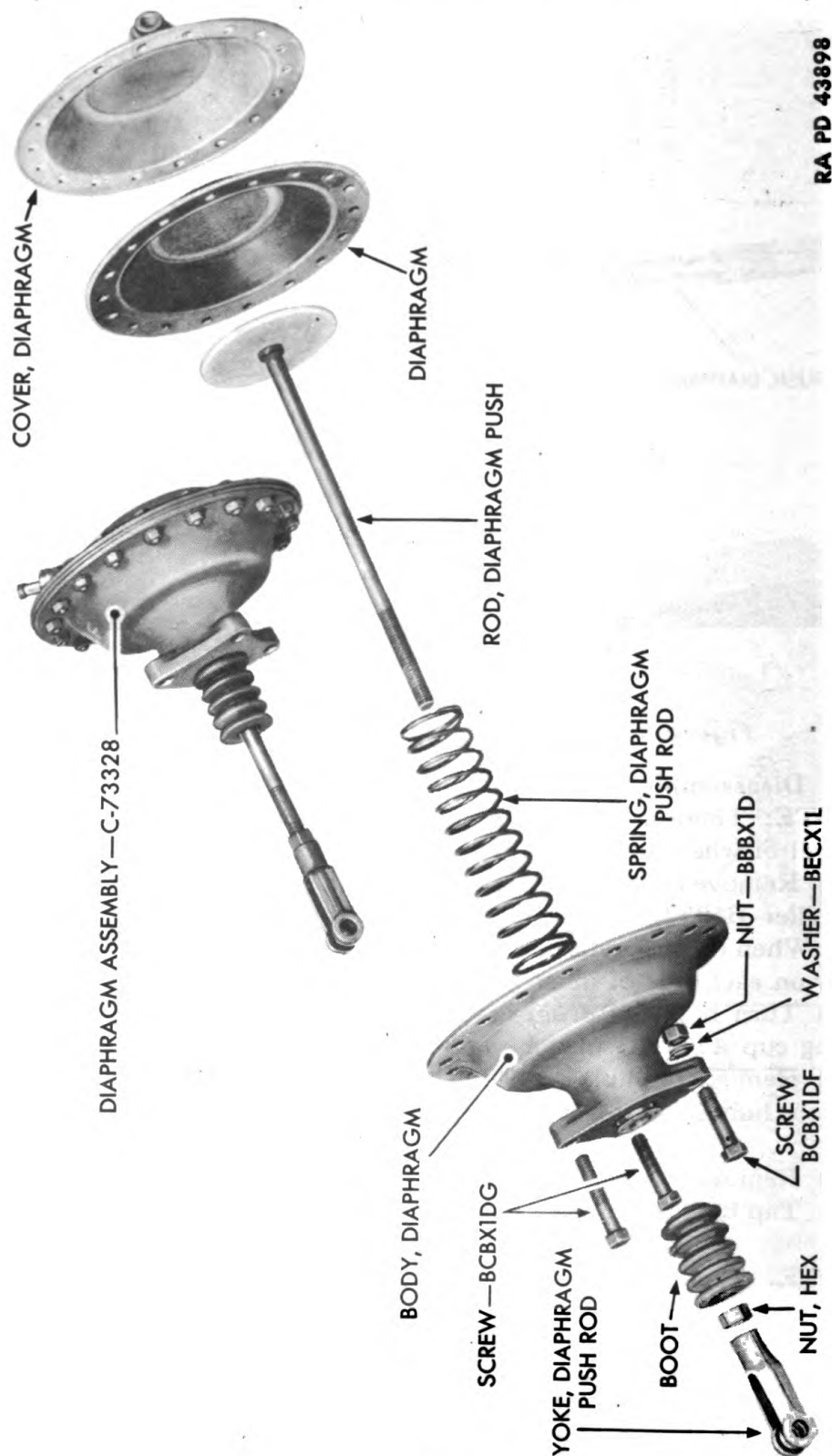
NOTE: Brake drum inspection hole cover A159546 can be removed by removing screw BCAX3C and washer BECX1K (fig. 300).

(6) Repeat procedure as described in steps (1) through (5) above to disassemble other three wheel hub and drum assemblies.

i. Disassemble Wheel Brake Assembly.

(1) Bend ends of lock A155862 away from nuts A157614 (fig.

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 43898

Figure 298—Air Brake Diaphragm

BRAKE MECHANISM

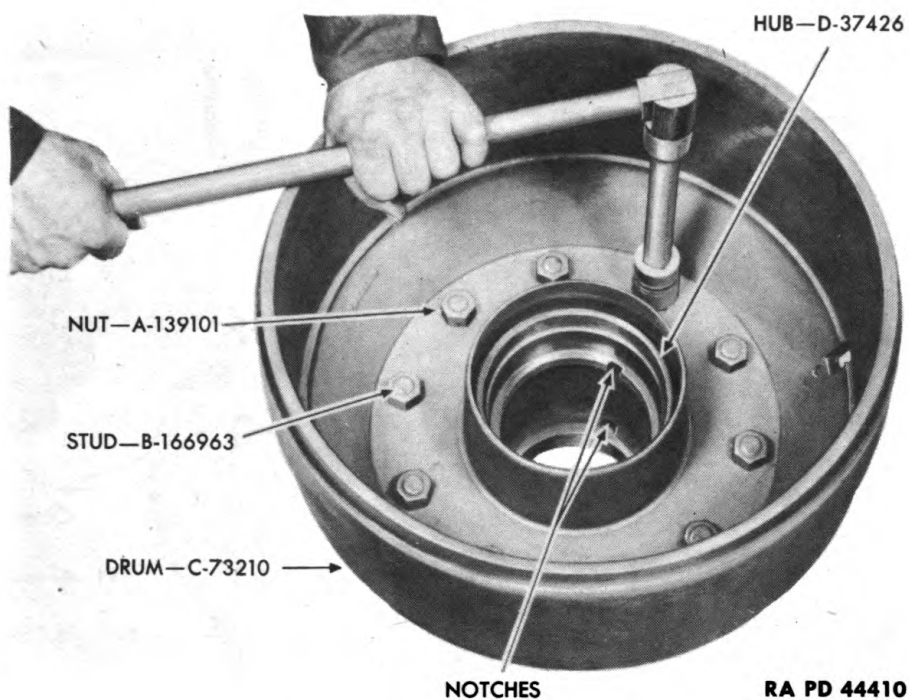


Figure 299—Removing Brake Drum

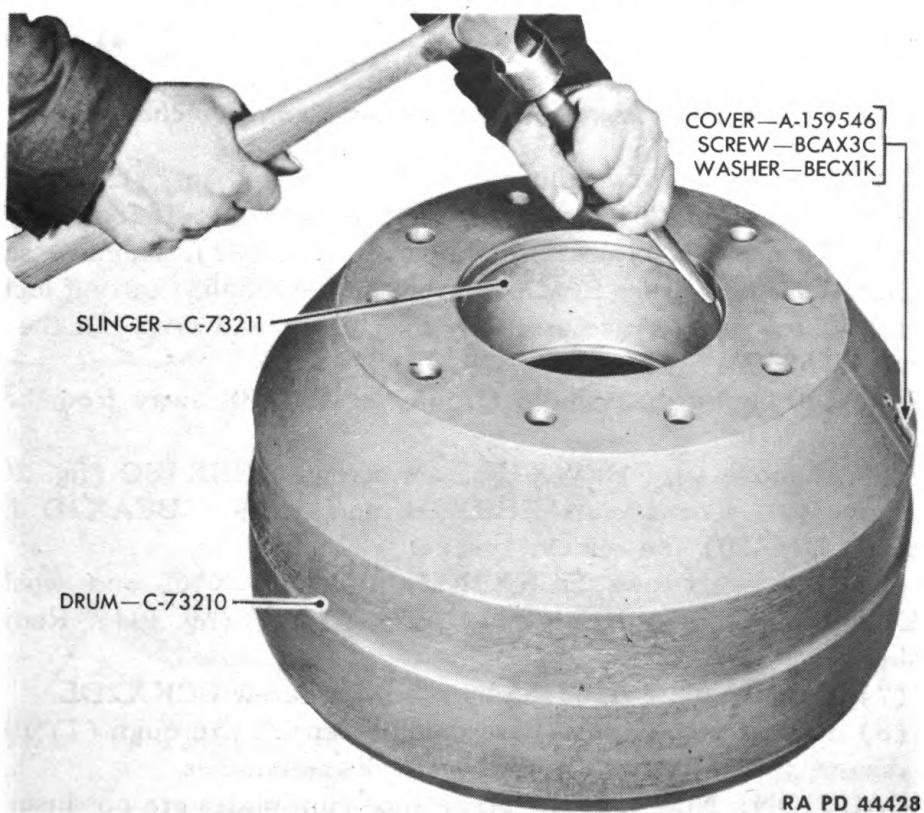
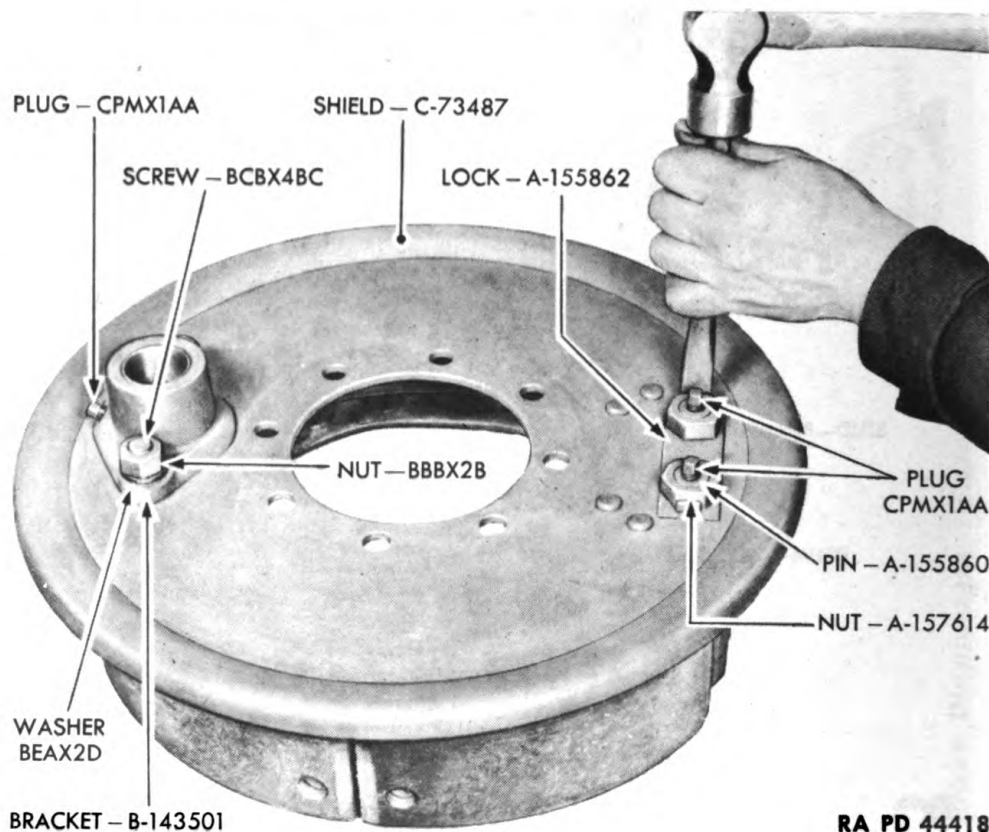


Figure 300—Removing Brake Drum Grease Slinger

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44418

Figure 301—Removing Nut from Brake Anchor Pin

301). Then remove two plugs CPMX1AA from pins A155860. Remove two nuts A157614 from pins, and lift off lock A155862.

(2) Turn wheel brake assembly over (fig. 302). Remove screw BCAX1BB and washer BECX1H from lock A155863. Lift off lock.

(3) Turn wheel brake assembly over again, and drive out the two pins A155860.

(4) Lift brake dust shield C73487 or C73488 away from brake shoes.

(5) Remove wire BFWX1B from screws BCBX4BC (fig. 303). Remove two screws, nuts BBBX2B, and washers BEAX2D from bracket B143501 and remove bracket.

(6) Remove screws BCKX2EM, nuts BBAX1C, and washers BECX1K from lining B127237 and shoe C53238 (fig. 304). Remove lining.

(7) Remove plate A146155 by removing screw BCKX2DL.

(8) Repeat procedure as described in steps (1) through (7) above to disassemble the other three wheel brake assemblies.

CAUTION: Note that the brake shoe cam plates are not installed the same way in the upper and lower brake shoe assemblies.

BRAKE MECHANISM

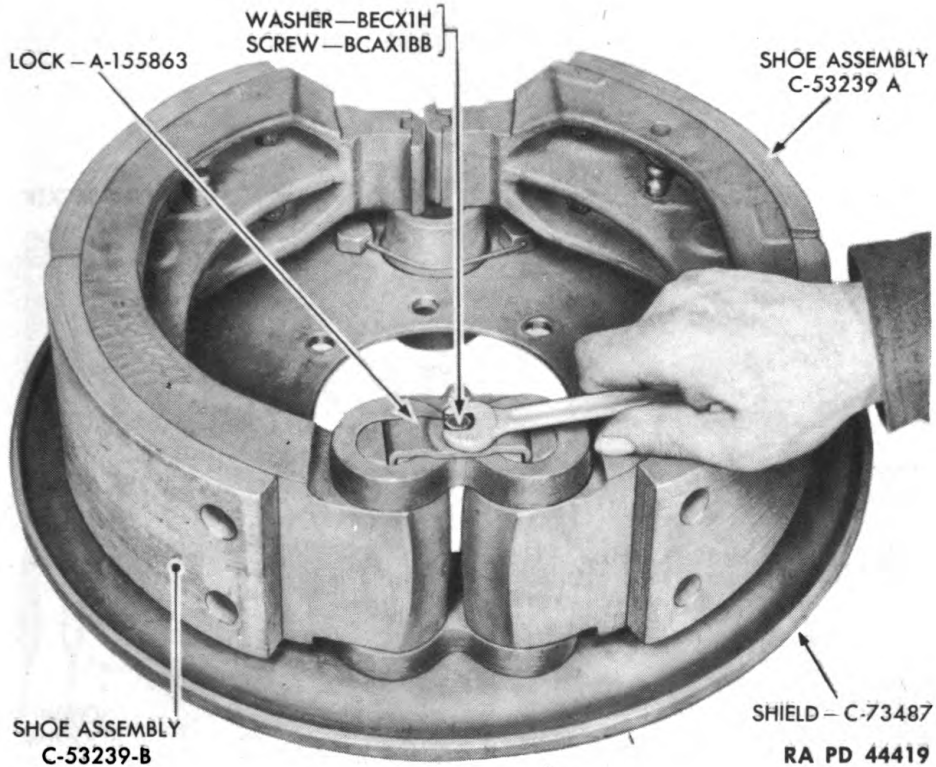


Figure 302—Removing Brake Shoe Anchor Pin Lock

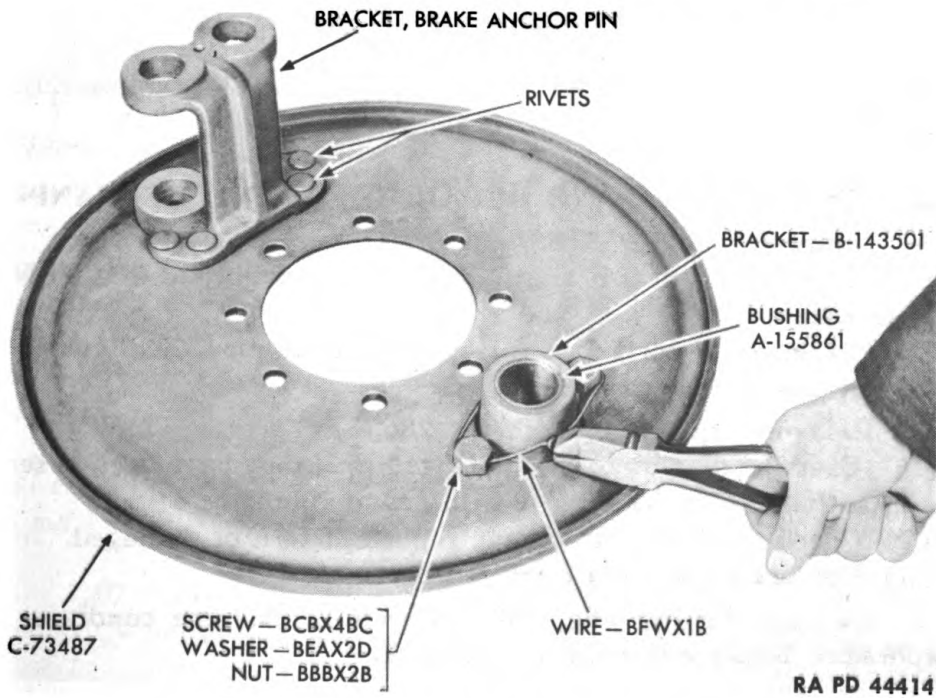


Figure 303—Removing Brake Cam Bracket

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

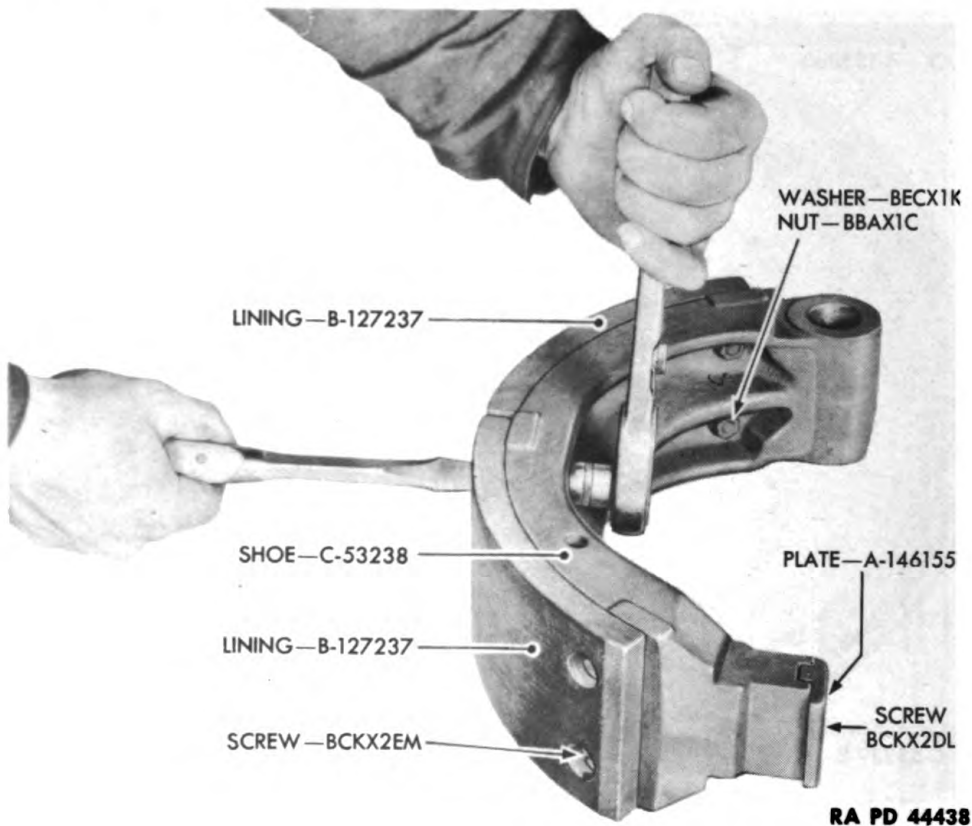


Figure 304—Removing Brake Lining

(9) The wheel brake assemblies are now completely disassembled (fig. 305).

110. MAINTENANCE AND REPAIR OF BRAKE MECHANISM.

a. General.

(1) Clean all parts of brake mechanism thoroughly in **SOLVENT**, dry-cleaning.

(2) Examine all parts for wear or damage. Replace badly worn or damaged parts with new parts.

b. Relay-emergency Valve (fig. 286).

(1) Examine diaphragms. If damaged, or if they have been in service more than 6 months, replace with new diaphragms.

(2) Check condition of gaskets; replace if torn or damaged.

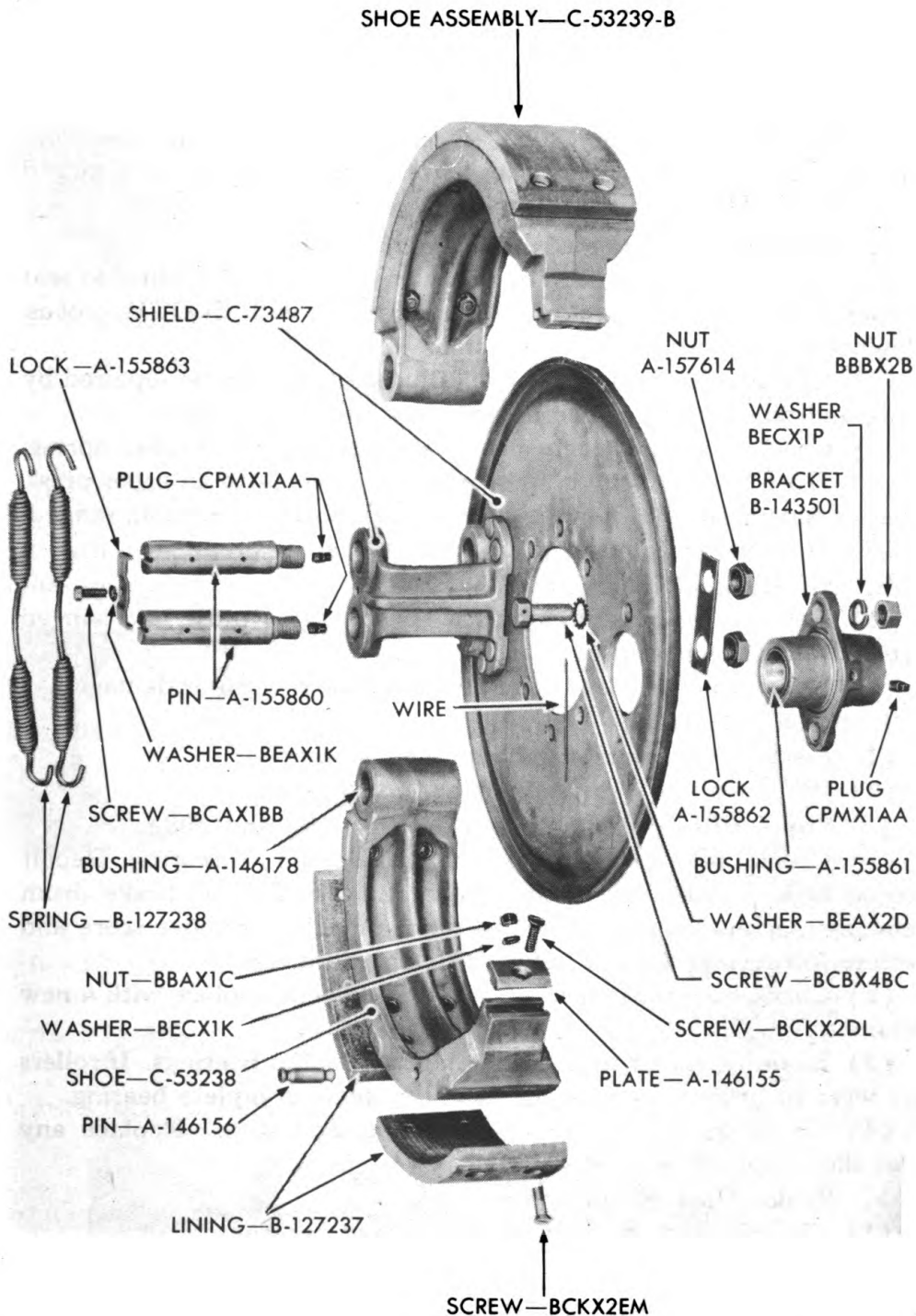
(3) Replace all worn or damaged parts.

c. Exhaust Fitting (fig. 289). Carefully examine condition of diaphragm. Replace if worn or damaged.

d. Air Filter (fig. 290).

(1) Check condition of gaskets; replace when worn or damaged.

BRAKE MECHANISM



RA PD 44598

Figure 305—Wheel Brake Parts—Exploded View

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

(2) Replace strainer assembly if it has seen hard service and is unusually dirty.

e. Air Hose Coupling. Replace old, worn, or damaged rubber washers in air couplings (fig. 295).

f. Air Reservoir (fig. 306). Check condition of air reservoir. Fill reservoir with air and listen for leaks. Replace a leaky or damaged air reservoir. Do not immerse reservoir in water.

g. Hand Brake Lever Group (fig. 296).

(1) Examine latch of each brake lever. If point is too blunt to seat properly in rack, file to desired form, and polish with CLOTH, crocus. Replace badly worn or damaged latch.

(2) Examine teeth of each plate. Blunted teeth can be repaired by filing and polishing. Replace damaged or badly worn plate.

(3) Check tension of each spring. Replace weak or broken spring.

(4) Worn bushings can be pressed out of lever with an arbor press. Coat outside surface of new bushing with TALLOW, mutton, refined, or LEAD, white, and press into position with arbor press.

h. Air Brake Diaphragms (fig. 298).

(1) Replace ruptured diaphragm. Diaphragms must be changed every 6 months when in constant service.

(2) Replace entire diaphragm assembly when worn or damaged.

i. Slack Adjusters.

(1) Slack adjusters must be kept well lubricated.

(2) When worn or damaged, replace entire unit.

j. Wheel Hub and Drum Group (figs. 256 and 308).

(1) Check braking surface of each brake drum for scoring. Repair scored brake drums by refacing the braking surface on brake drum refacing machine or lathe. Cut just deep enough to remove score and restore full-surface contact between lining and drum.

(2) Check each inner bearing retainer. If bent, replace with a new retainer.

(3) Examine each pair of inner and outer roller bearings. If rollers are worn or bruised, or cups are scored, replace complete bearing.

(4) Check threads on all bolts, screws, and studs. Replace any that show signs of wear or stripping.

k. Brake Dust Shields (fig. 303).

(1) Check condition. If bent or damaged, replace.

(2) Tighten loose rivets in brake anchor pin bracket with a hammer and rivet set.

l. Brake Cam Bracket (figs. 302 and 303).

(1) Replace bushing in brake cam bracket if worn. Press old bushing out with an arbor press.

(2) Coat outside surface of new bushing with TALLOW, mutton, refined, or LEAD, white, and press into place with an arbor press.

BRAKE MECHANISM

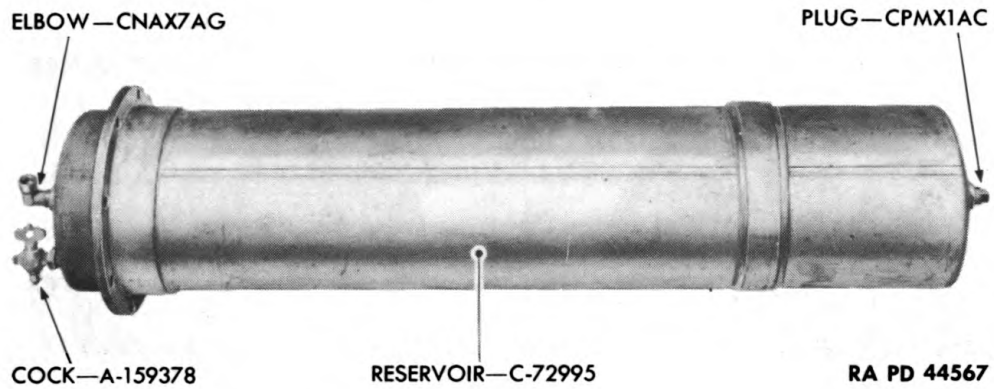


Figure 306—Air Reservoir

m. Brake Shoes.

- (1) Replace badly glazed or worn brake lining.
- (2) Replace a bent, loose, or broken brake spring pin. Pry old pin out with a pinch bar (fig. 307). Coat outer surface of new pin with tallow or lead and drive into place in brake shoe.

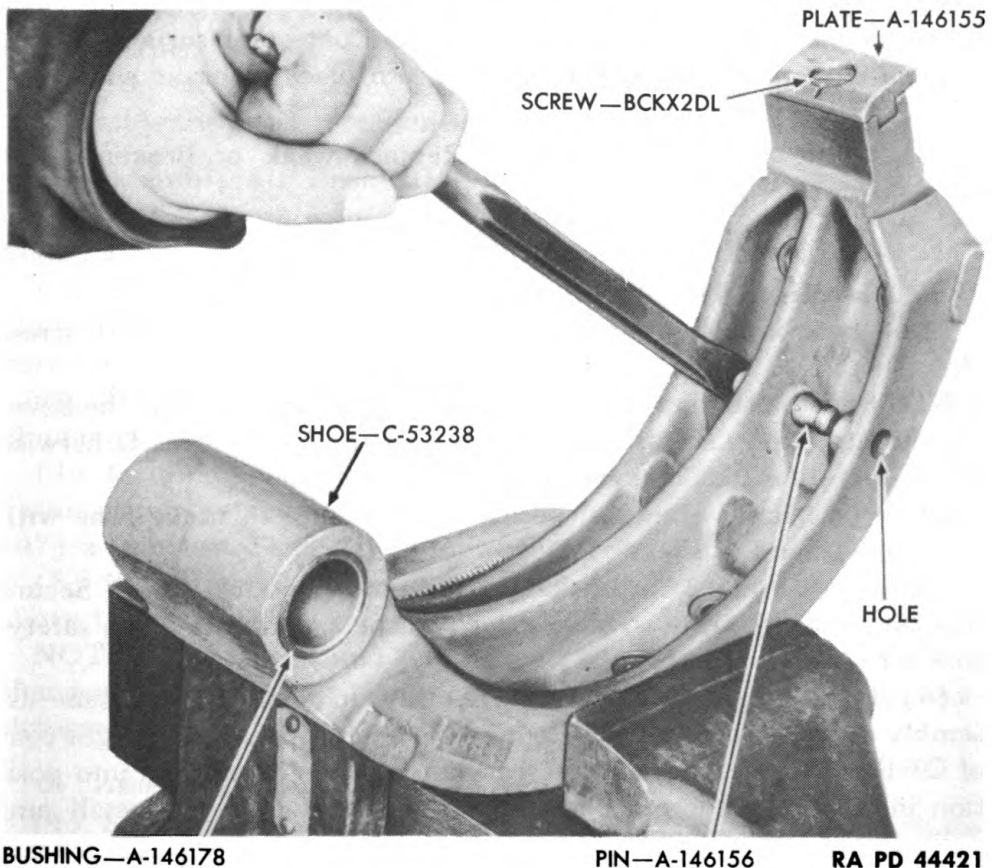


Figure 307—Removing Brake Spring Pin
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**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

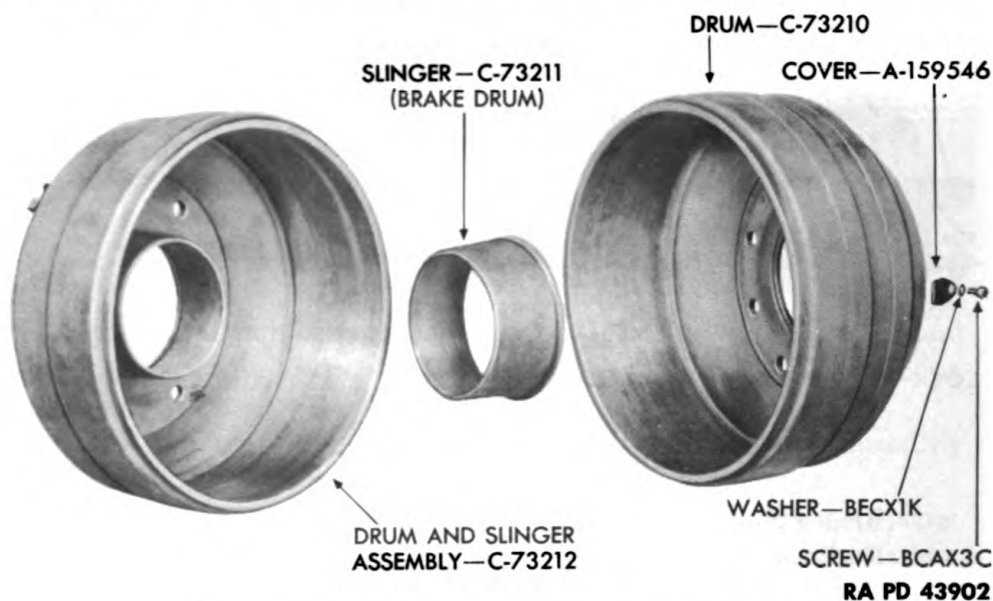


Figure 308—Drum and Slinger Assembly

(3) Worn bushings A146178 must be replaced with new bushings. Press old bushing out with an arbor press. Coat outer surface of new bushing with tallow or lead, and press into place in brake shoe with an arbor press.

n. Brake Springs (fig. 305). Replace weak or broken brake shoe springs.

111. ASSEMBLE BRAKE MECHANISM.

a. Assemble Wheel Brake Assembly (fig. 305).

(1) Place brake shoe cam plate in position and secure with screw (fig. 304).

NOTE: Be sure to install brake shoe cam plates properly; the bevel edge to inside on lower shoe and to outside on upper shoe. Otherwise brake operation cam action will not be correct.

(2) Place brake lining in position, and secure to brake shoe with screws, nuts, and washers.

(3) Insert brake cam bracket in place in brake dust shield. Secure bracket to shield with two screws, lock washers, and nuts. Then safety-wire screws in place (fig. 303).

(4) Install upper brake shoe assembly and lower brake shoe assembly on brake dust shield. Coat brake anchor pins with a light coat of **GREASE**, general purpose (seasonal grade). Drive pins into position in brake anchor pin bracket and shoes. Be sure to install pins with slotted ends on the brake shoe side.

(5) Place brake shoe anchor pin lock in position (fig. 302), and secure with screw and washer.

BRAKE MECHANISM

(6) Turn assembly over and install brake shoe anchor pin nut lock (fig. 301). Screw nuts on and bend up lips on end of lock to secure nuts.

(7) Screw two pipe plugs into ends of brake anchor pins.

(8) Repeat procedure as described in steps (1) through (7) above to assemble the other three wheel brake assemblies.

b. Assemble Wheel Hub and Brake Drum.

(1) Secure brake drum inspection hole cover to brake drum with screw and washer.

(2) Assemble brake drum and slinger assembly (figs. 300 and 308).

(3) Drive ten wheel studs into place in wheel hub.

(4) Place drum and slinger assembly in position on wheel studs and hub, and secure with ten nuts. Tighten nuts securely.

(5) Coat outer surfaces of inner and outer roller bearing cups with **TALLOW**, mutton, refined, or **LEAD**, white. Tap cups in place in hub.

(6) Lubricate inner bearing cone and roller with sufficient **GREASE**, general purpose, No. 2, to cover the rollers. Install cone and roller in the inner cup in hub.

(7) Place retainer in hub, with the sealing member toward the roller bearing.

(8) Repeat procedure as described in steps (1) through (7) above to assemble the other three wheel hub and brake drum assemblies.

c. Assemble Air Brake Diaphragm (fig. 297 and 298).

(1) Install diaphragm push rod spring on diaphragm push rod. Slide rod and spring into position in diaphragm body.

(2) Install diaphragm in diaphragm cover, and fasten cover to diaphragm body with cap screws, lock washers, and nuts. The cap screws must be inserted from the cover side.

(3) Install boot on diaphragm push rod, and screw nut on diaphragm push rod.

(4) Install diaphragm push rod yoke. Turn yoke on or off rod until distance from center of hole in yoke to edge of diaphragm body (fig. 297) is 9 inches. Then tighten nut against yoke.

(5) Repeat procedure as described in steps (1), (2), (3), and (4) above to assemble the other three air brake diaphragms.

NOTE: Right front and left rear air brake diaphragms are interchangeable; also the left front and right rear air diaphragms are interchangeable.

d. Assemble Hand Brake Lever (fig. 296).

(1) Slide hand brake lever rod spring on rod. Push rod through lug on hand brake lever. The spring must be below lug. Screw hand brake lever connector on top end of rod.

(2) Install hand brake lever latch, and connect latch to lever and

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

rod with two headless pins and four cotter pins.

(3) Place hand lever in position on brake lever and connector, and secure with two headless pins, washers, and cotter pins.

e. Assemble Air Hose Coupling (fig. 295).

(1) Place air hose coupling in vise fitted with copper jaws.

(2) Insert washer in coupling. If a new washer is being inserted, it may be necessary to trim outer edge of washer to get it to fit properly in the coupling recess.

(3) Place the plate over rubber washer, and secure plate to coupling with four screws.

f. Assemble Air Line Pipe and Clamp Group.

(1) Place air line front bracket in vise fitted with copper jaws. Connect compression tube connector to bracket (fig. 294).

(2) Screw air line connecting sleeve to air line front bracket (fig. 291).

(3) Screw part of connector A144525A into place in bracket (fig. 293).

(4) Remove the assembly from vise.

(5) Place air line rear bracket in vise. Assemble bracket, pipe, tube, connector, and sleeve to bracket (fig. 292).

(6) Screw nipple and coupling into place in rear bracket (fig. 292).

g. Assemble Air Filter (fig. 290).

(1) Install the large rubber gasket in recess in top flange of filter body.

(2) Place strainer assembly in position in body. Place strainer support on top of strainer assembly.

(3) Install chamber in place over support, and secure to body with two cap screws. Screw plug in top of cover.

(4) Install gasket in side flange, and secure flange and gasket to body with two cap screws.

(5) Repeat procedure as described in step (4) above to mount the other side flange and gasket.

h. Assemble Exhaust Fitting (fig. 289).

(1) Place diaphragm in the recess in large end of exhaust fitting body.

(2) Place diaphragm washer on top of diaphragm, with the concave side of washer out. Secure diaphragm and washer to body with lock washer and screw.

i. Assemble Relay-emergency Valve (figs. 286, 287, and 288).

(1) **ASSEMBLE EMERGENCY VALVE BODY AND RELAY VALVE BODY.**

(a) Install the supply valve bushing in the relay valve body. Install the emergency valve stem seat in the emergency valve body.

(b) Place the emergency valve body and relay valve body together with the gasket in between them and install the four retaining bolts and washers. Install pipe plugs.

BRAKE MECHANISM**(2) ASSEMBLE EMERGENCY PORTION OF RELAY-EMERGENCY VALVE.**

(a) Install the emergency valve stem, support, diaphragm spring, diaphragm spring seat, diaphragm, strainer spring seat, and diaphragm retaining nut. Install the bottom retaining nut in the emergency valve body (fig. 288).

(b) Assemble the strainer spring, strainer, gasket, and body cover to the emergency valve body.

(3) ASSEMBLE RELAY PORTION OF RELAY-EMERGENCY VALVE.

(a) Install the supply valve, spring, and spring retaining nut (fig. 287).

(b) Assemble diaphragm and guide group by assembling the diaphragm, washer, retaining nut, cotter pin, and guide ring. Then assemble the diaphragm and guide group, spring, retainer, gasket, and cover to the relay valve body.

(4) Screw exhaust fitting assembly into place in relay-emergency valve assembly.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

Section XXII

WHEELS AND TIRES

	Paragraph
General	112
Maintenance and repair	113

112. GENERAL.

a. The wheels and tires were removed and installed as part of the bogie disassembly and assembly procedures. These steps are covered in paragraphs 95 a and 101 g.

b. Wheels and tires can be removed and mounted without disturbing any other carriage units. The procedure outlined in above-mentioned paragraphs will be the same.

113. MAINTENANCE AND REPAIR.

a. Wheel Bearings.

- (1) Replace all scored or worn wheel bearings.
- (2) Paragraph 111 b contains the proper procedure for packing wheel bearings with grease when replacing bearings.

b. Wheels and Tires.

- (1) Replace all worn or badly damaged wheels, tires, and parts with new parts.
- (2) Paragraphs 73 and 74, TM 9-335, cover the proper procedure for removal and installation of tires and tubes.

Section XXIII

ASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

	Paragraph
Mount trails	114
Mount bogie	115
Mount top carriage	116
Mount recoil mechanism and trunnion bearing caps	117
Mount equilibrators	118
Mount barrel assembly, counterbalance, and breech mechanism	119
Put materiel in traveling position	120

114. MOUNT TRAILS.

a. Coat the trail hinge pin bearing surfaces in trail and bottom carriage with OIL, engine (seasonal grade). Wrap a heavy cable sling around the trail just ahead of spade rear brackets. This is approximately center of trail weight.

b. Make certain bottom carriage is mounted on four large wood blocks as described in paragraph 31 g.

c. Hook crane to cable sling placed around trail and lift trail into position. Balance trail so that it can be pushed into place in bottom carriage. Line up trail hinge pin holes in bottom carriage and trail.

d. Remove trail hinge pin top plug from trail hinge pin. Be sure to get the same trail hinge pin that came out of this side of bottom carriage. Insert the screw part only of trail hinge pin puller C76030 in place in top of trail hinge pin. Coat entire bearing surface of trail hinge pin with OIL, engine (seasonal grade). Lower trail hinge pin into place in trail and bottom carriage (fig. 309). Line up flat sides of trail hinge pin top with mating surfaces on top of bottom carriage. Be sure to get trail hinge pin all the way down. Remove puller screw.

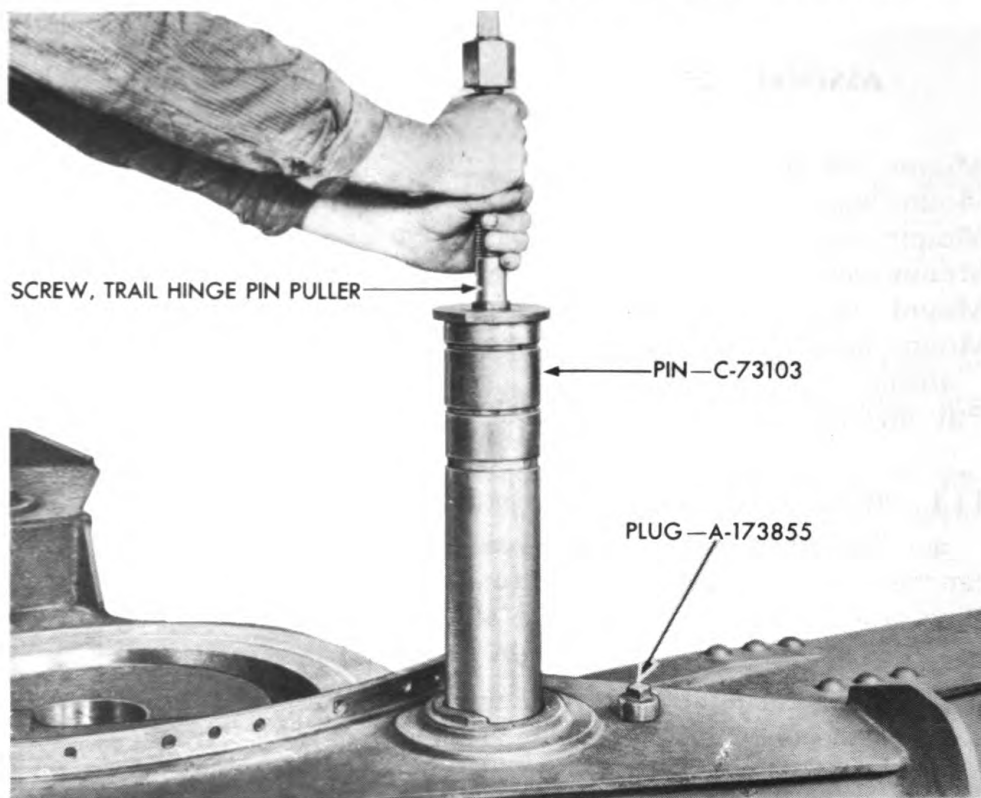
e. Pour OIL, engine (seasonal grade), into top of trail hinge pin. The oil will spread slowly; make certain that there is enough oil to cover the top plug. Screw trail hinge pin top plug in place.

f. Coat threads of trail hinge pin bottom plug and set screw with COMPOUND, rust-preventive, light, and screw bottom plug in place. Follow with set screw (fig. 57).

g. Connect air line hose between bottom carriage and air line bracket on trail.

h. Connect the air line hose between bottom carriage and air filter (fig. 234).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44581

Figure 309—Installing Trail Hinge Pin

i. Repeat procedure as described in subparagraphs a through h above to mount other trail.

j. In cases where a new trail or trails are being fitted to bottom carriage proceed as follows:

(1) Swing trails to the full open (firing) position and place rear of each trail on a wood block (fig. 310).

(2) Tie one end of a long (16-ft) stout cord around a piece of chalk. Place other end of cord on top center of trail hinge pin and strike an arc on floor near center of trail opening. Strike an intersecting arc from top center of other trail hinge pin (fig. 310).

(3) Attach the cord to the bottom carriage pipe plug and draw a line through intersection of two arcs to establish center line of carriage. Hold the rear end of cord so it is exactly above the intersection of the arcs. Measure the distance from the cord to each trail ("A" and "B," fig. 311). This distance should be the same on both sides of the cord; otherwise, the carriage will be out of balance for firing.

(4) In cases where there is a variation greater than $\frac{1}{2}$ inch in the two measurements, it will be necessary to grind metal off the pads on the outside of the trail that does not open as far as the other (fig. 312). Remove just enough metal to obtain proper measurement.

ASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

RA PD 44970

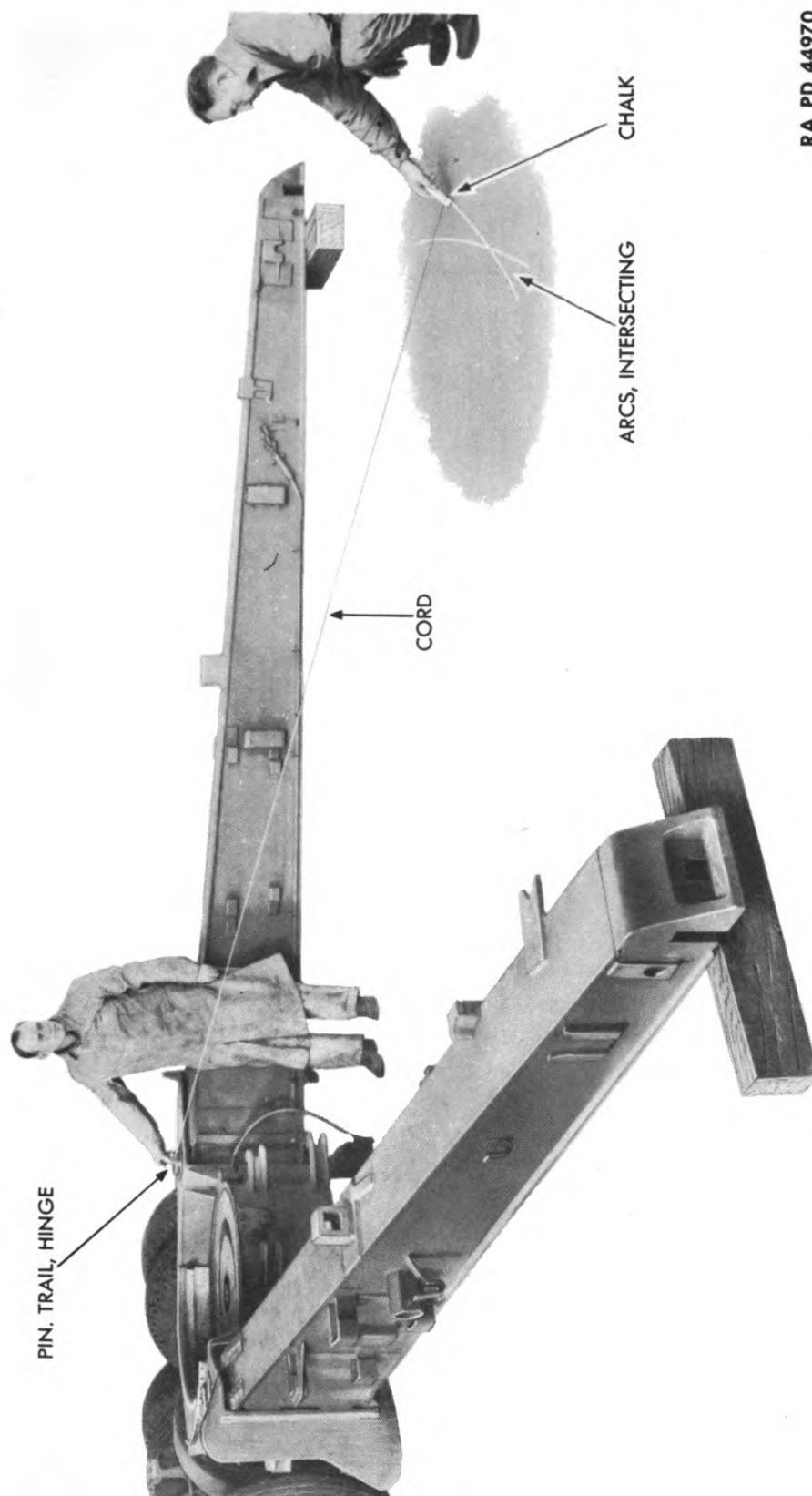
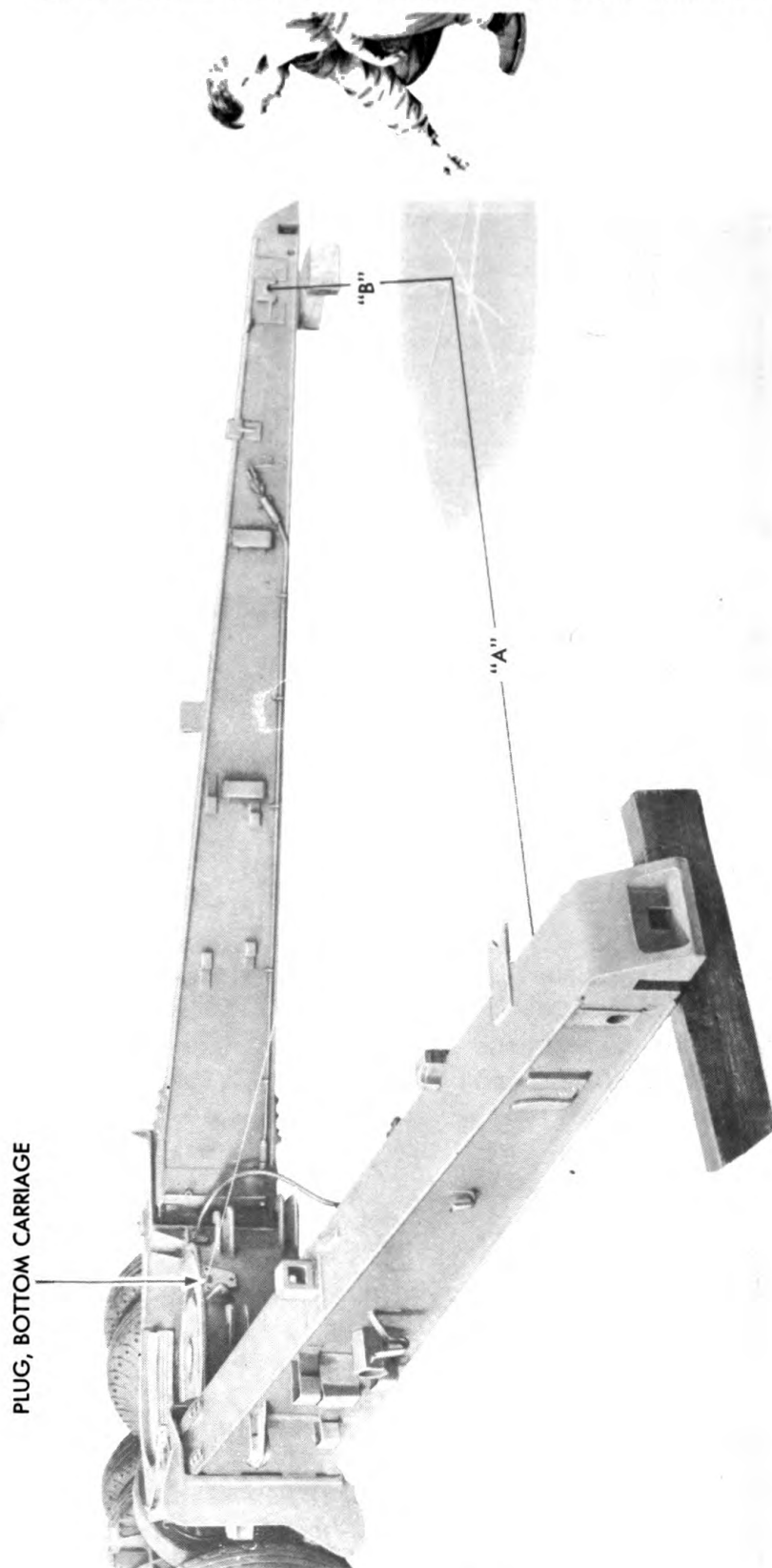


Figure 310—Establishing Center Line of Carriage

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 45126

Figure 311 — Measuring Trail Spread

ASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

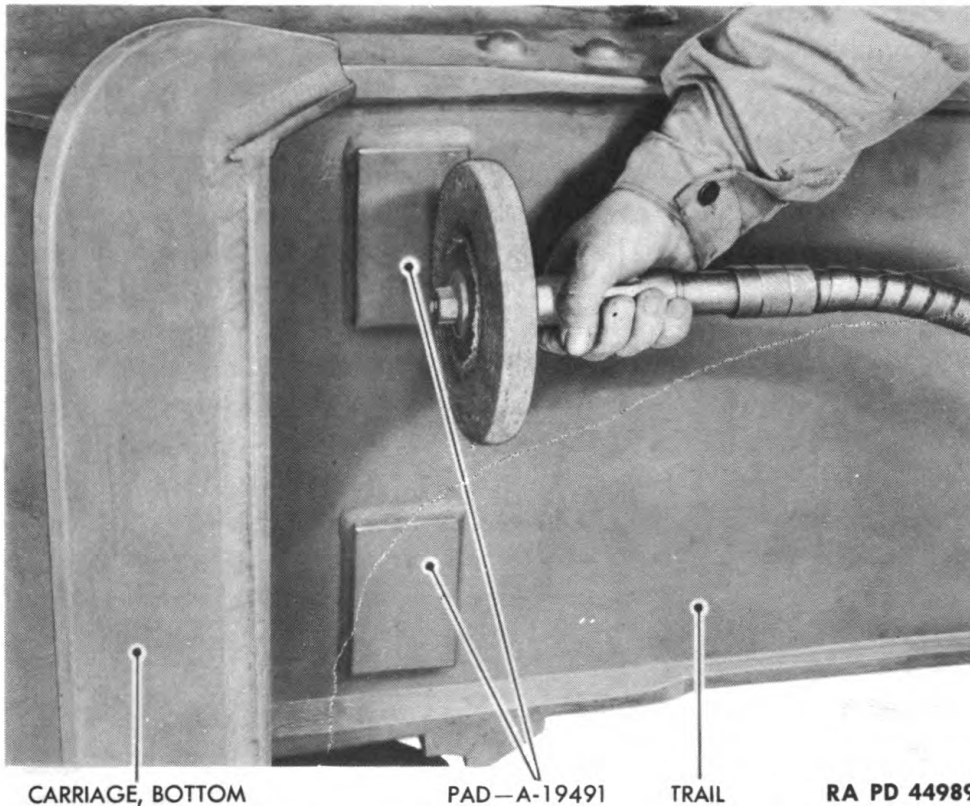


Figure 312—Grinding Trail Pads

115. MOUNT BOGIE.

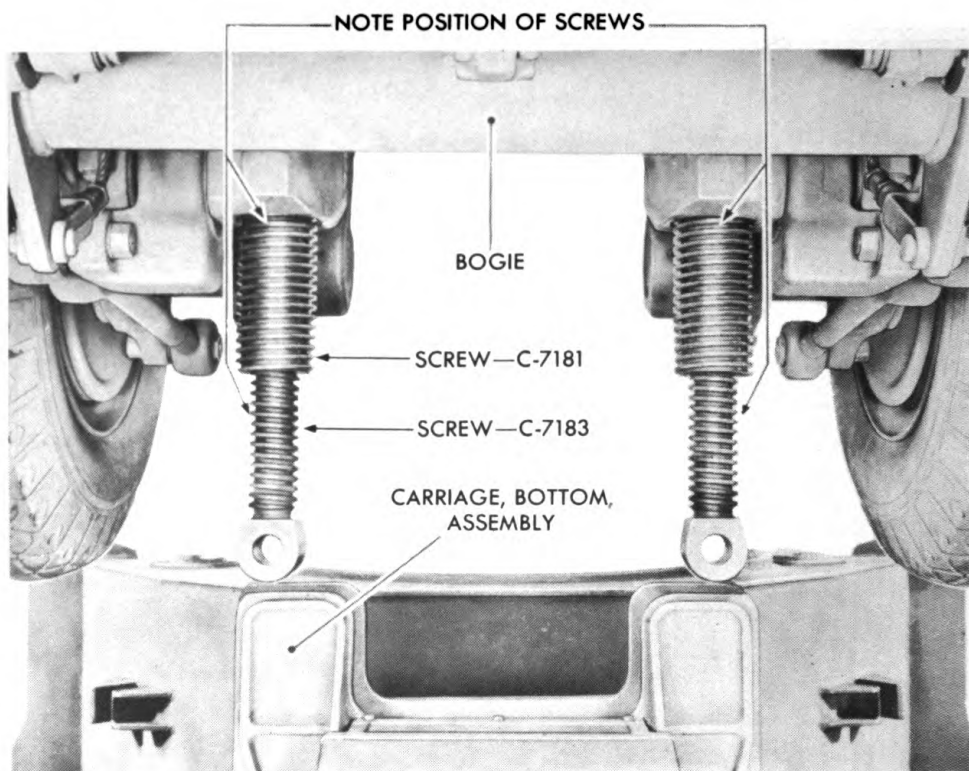
a. Place a round steel bar 12 inches long x 1 $\frac{3}{8}$ -inch diameter through hole in cradle lock eyebolt (fig. 56). Then place a heavy cable sling around the steel bar and lift bogie assembly up over the bottom carriage. Line up bogie lifting screws with brackets integral with bottom carriage (fig. 313).

NOTE: Check the position of bogie lifting screws. They must be the same for proper mounting. Fourteen threads of inner screw should be below bottom of outer screw. Sixteen threads of outer screw should be below crossbeam.

b. Lower the bogie into place on bottom carriage. Two men should guide the bogie lifting screws as the bogie is being lowered into place. Line up holes in bottom of inner lifting screws and in bottom carriage.

c. Coat bearing surface of each bogie attachment pin with grease. Insert bogie attachment pins in place in bottom carriage and bogie inner lifting screws. The pin must be inserted from the front; nuts at the rear. Coat pin threads with COMPOUND, rust-preventive, light. Screw nuts on and secure with cotter pins. (Use bogie trunnion nut

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8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 44584

Figure 313—Installing Bogie

and lifting screw shackle pin wrench B105336 and a $1\frac{13}{16}$ -in. socket wrench with ratchet handle.)

d. Using two bogie lifting screw ratchet wrenches C7357, lower bogie, and raise bottom carriage to traveling position. Remove four large wood blocks from under bottom carriage.

e. Connect the air line hoses at the four brake diaphragms.

f. Remove the four wheel supporting cables from the crossbeam torque bracket bolts and place in position on the four upper torque rod hooks (fig. 53).

g. Set the hand brakes.

h. Replace bogie lifting screw covers, secure with thongs, and replace bogie lifting screw lock (fig. 52).

116. MOUNT TOP CARRIAGE.

a. Place a heavy cable sling around the hook in the front inside of top carriage, and another around the rear top of the top carriage (fig. 51). Place the rear trunnion bearing cap bolts A19762 (fig. 41) back in holes in top carriage to keep cable sling from slipping off. Use a crane to lift top carriage up and guide it carefully into position. Coat

ASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

top surface of bottom carriage circular liner with **GREASE**, general purpose (seasonal grade). Line up pintle with pintle bushing in bottom carriage and lower top carriage into place.

b. Tap pintle down into pintle bushing with a copper hammer.

c. Coat all surfaces of the pintle bolt roller bearing races and roller section with **GREASE**, general purpose (seasonal grade). Place the bearing in position in top of pintle. **NOTE:** The upper and lower races of this bearing are interchangeable.

d. Insert the pintle bolt from bottom of bottom carriage after greasing entire pintle bolt. Screw pintle bolt nut on pintle bolt and on top of pintle bolt roller bearing.

e. Place pintle bolt nut wrench B158723 in position on pintle bolt nut with slot in wrench on rib in top carriage (fig. 48).

f. Using special socket wrench B105331, wood block, and steel bar, tighten pintle bolt (fig. 47). Be sure to get the pintle bolt in tight. Line up cotter pin hole and replace cotter pin (fig. 46).

g. Place the pintle bolt cover in place over pintle bolt nut. Coat threads of four pintle bolt cover screws with **COMPOUND**, rust-preventive, light. Secure cover to pintle with four screws and washers (fig. 45). Be sure lubrication fitting is in place in cover.

h. Coat threads of bottom carriage pintle bearing plug with **COMPOUND**, rust-preventive, light, and screw plug into position in bottom of bottom carriage with special spanner wrench B167062.

NOTE: The bottom carriage seal, two bottom carriage rebound liners, and the bottom carriage clip are not replaced until after recoil mechanism and barrel assemblies are mounted (par. 119 j).

117. MOUNT RECOIL MECHANISM AND TRUNNION BEARING CAPS.

a. Mount Trunnion Bearing Cap Group.

(1) Coat the cradle trunnion and pin with **GREASE**, general purpose (seasonal grade), and lift the trunnion bearing cap in place (two men) (fig. 88).

(2) Coat the removable bearing mounting sleeve with a light film of grease and slide it in place. Tap in with a small wood block and hammer.

(3) Coat the threads of trunnion pin with **COMPOUND**, rust-preventive, light, and place the bearing lock washer in place on trunnion pin with lugs inclined outward. Screw the bearing lock nut in place with trunnion bearing nut spanner wrench B105516.

(4) Secure the nut by bending one of the lock washer lugs down on nut (fig. 85).

(5) Coat the threads of trunnion bearing closure cap with **COM-**

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

POUND, rust-preventive, light. Screw cap in place in trunnion bearing cap with trunnion spanner wrench C7360 (fig. 84).

(6) Repeat procedure as described in steps (1) through (5) above to mount the other trunnion bearing cap group.

b. Mount Recoil Mechanism and Trunnion Bearing Caps. String a 1-inch diameter cable through the equilibrator bracket eyes and around sheave bracket at rear of cradle. Cross the cable in the center where it fits over crane hook (fig. 43). Fasten cable securely with two 1-inch cable clamps. Place cable sling over crane hook and lift slowly. Make certain that weight is equalized and recoil mechanism is lifted evenly in front, rear and sideways.

c. Support cradle trunnion bearing cap assemblies; otherwise, they will swing down and may be damaged (fig. 43). Two men will be needed to guide trunnion bearing caps and variable recoil connecting rod while the recoil mechanism is being lowered in position on top carriage. Grease mating surfaces of trunnion bearing caps and top carriage, and lower recoil mechanism into position. Remove crane and cable sling.

d. Lock the cradle in traveling position by means of cradle lock pin (fig. 44).

e. Connect variable recoil connecting rod to bracket on top carriage. Coat surface of connecting rod headless pin with COMPOUND, rust-preventive, light. Insert headless pin in place in connecting rod and top carriage bracket, and secure with two cotter pins (fig. 42).

f. Coat the threads of the four trunnion bearing cap bolts with COMPOUND, rust-preventive, light. Install the two short bolts and washers in place in front of each trunnion bearing cap (fig. 42).

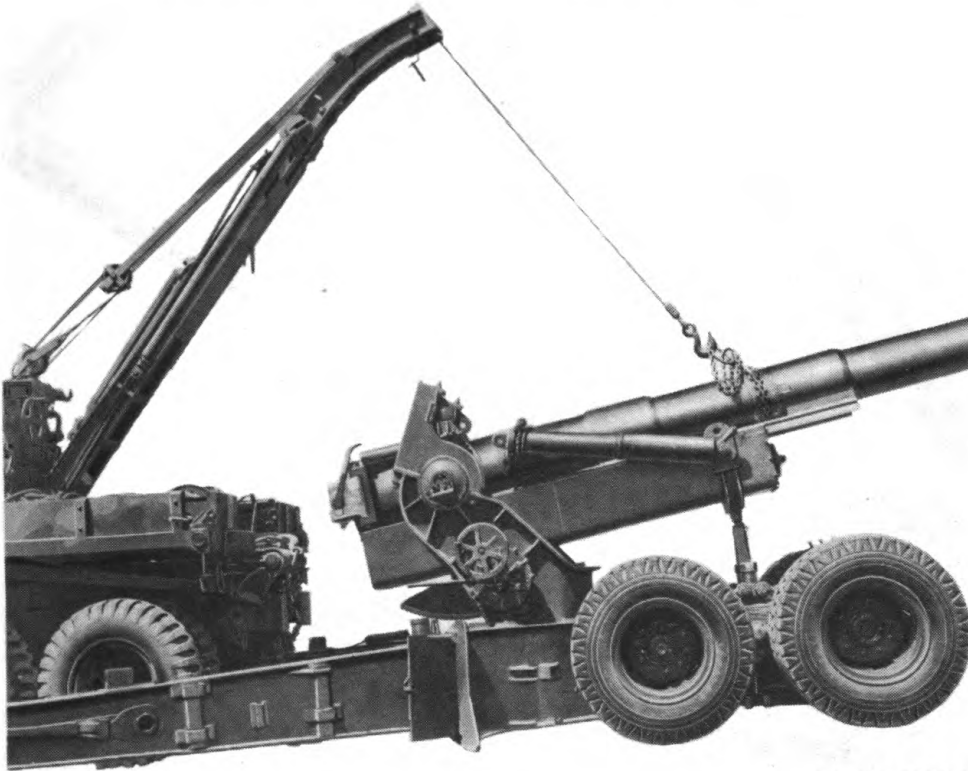
g. Install the two long bolts, washers, and nuts in place in rear of each trunnion cap (fig. 41). Place bolts in through top of trunnion caps, with nuts and washers on outside bottom.

h. Tap sheave and bearing assembly in place in sheave bracket at top of cradle. Push locking pin in place and lock sheave and bearing in place.

118. MOUNT EQUILIBRATORS.

a. Two methods of removing equilibrators from the carriage are described in paragraph 27. If Method 1 was used, the equilibrators can be installed by reversing the procedure described in paragraph 27 b (1) through (8).

b. If Method 2 was used, the unserviceable equilibrators (or equilibrators) may be replaced as described below.

ASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

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Figure 314a—Replacing Equilibrator Using Heavy Wrecking Truck M1—Cradle Lock Engaged

CAUTION: Extreme care must be taken when elevating and depressing the barrel. It is advisable that one man be assigned the responsibility of releasing and engaging the elevating brake and manipulating the elevating handwheel.

(1) Set the temperature adjustment for the equilibrator to be replaced at zero F.

(2) Secure the front end of the equilibrator to the cradle with washer, nut, and cotter pin. Rig the barrel and equilibrator as shown in figure 314 a.

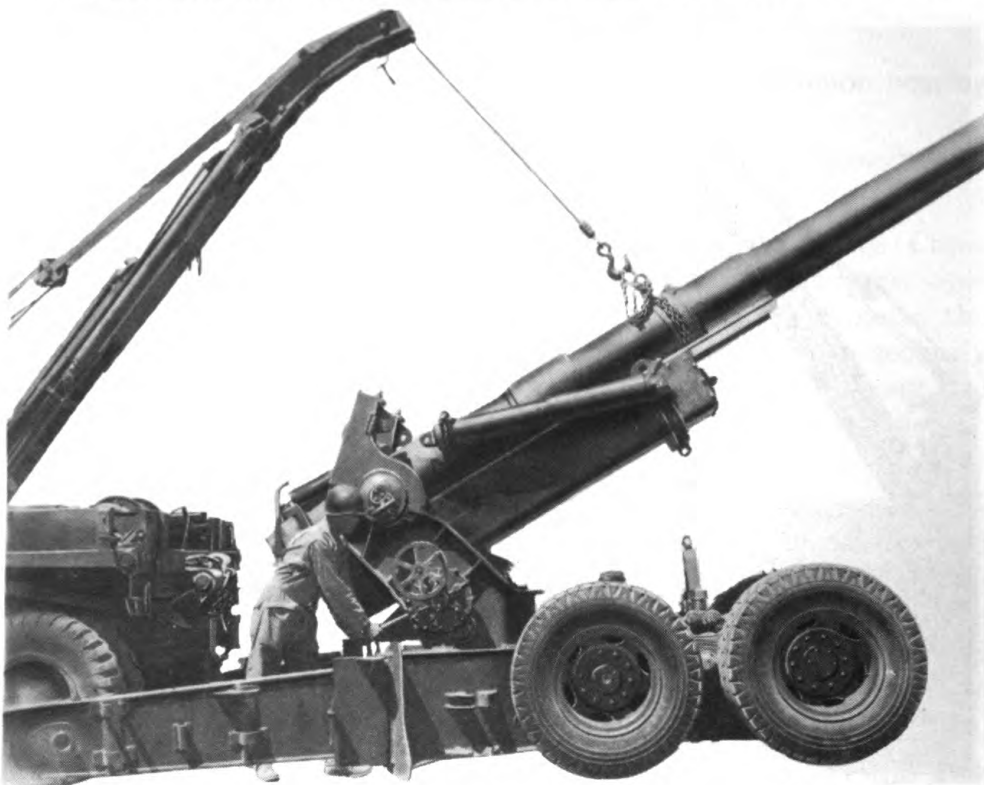
(3) Disengage the cradle traveling lock and release the elevating brake mechanism.

(4) Elevate the barrel using the crane as shown in figure 314 b. **CAUTION:** Do not touch the elevating handwheel. The elevating brake lever should remain depressed at all times.

(5) With the tube elevated to maximum, engage the equilibrators as shown in figure 314 c. (Note that the handwheel may be rotated enough to obtain fine adjustment so that the equilibrator connecting shaft may be assembled readily.)

(6) Set the temperature adjustment to the proper temperature.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 80065

Figure 314b—Replacing Equilibrator Using Heavy Wrecking Truck M1—Cradle Lock Disengaged

- (7) Depress to zero and remove rigging from equilibrator.
- (8) Repeat procedure as described in steps (1) through (7) above, to replace the other equilibrator.

119. MOUNT BARREL ASSEMBLY, COUNTERBALANCE, AND BREECH MECHANISM.

NOTE: The operations for mounting the barrel assembly are the same for either the 155-mm gun barrel or the 8-inch howitzer barrel.

- a. Be sure that the cradle lock is in the locked position and bogie hand brakes are set.
- b. Lubricate the gun rails and cradle slides thoroughly with OIL, engine (seasonal grade).
- c. Place heavy cable slings wrapped in cloth around the barrel assembly; one just ahead of the front barrel hoop near the front of the gun rails, and the other around the breech ring. **NOTE:** It will be necessary to open breech to place the rear sling in position (figs. 38 and 39).
- d. Lift the barrel up evenly (front and rear) and move to a

ASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE



RA PD 80066

Figure 314c—Securing Equilibrator in Place

position directly behind the recoil mechanism. Line up the gun rails with the rail slides in the cradle and move barrel straight forward until the gun rails enter the cradle slides (fig. 37).

e. Remove the front cable sling and place it around the barrel ahead of the trunnion bearing caps.

f. Make certain the gun rails are level with gun rail slides in cradle; then move barrel all the way forward into battery.

g. Remove the cable slings.

h. Close breech mechanism and install firing mechanism assembly.

i. Secure barrel to counterrecoil and recoil piston rod ends with nuts, washers, and cotter pins, after coating threads with COM-POUND, rust-preventive, light (figs. 11 and 12). NOTE: It is necessary to allow a slight floating of the piston rods in the breech ring lug to prevent excessive wear on the stuffing boxes due to slight irregularity in alinement of the recoil mechanism. Draw nuts tight; then back them off enough to allow approximately 0.005-inch end play between breech ring lug, and recoil and counterrecoil piston rod yoke.

j. **Install Rebound Liners and Seal, and Rear Hold-down Clip.**

(1) Coat the three hold-down clip screw threads with COM-

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

POUND, rust-preventive, light. Secure clip in place on rear of top and bottom carriages with the three retaining screws and washers. The short screw goes in the bottom hole (fig. 34).

(2) Coat the male and female rebound liners all over with a light film of OIL, engine (seasonal grade) (fig. 32). Slide the female liner in place between top and bottom carriage (oil groove side down) from left side of top carriage. Slide the male liner in place from the right side of top carriage (oil groove side down). **NOTE:** If it is difficult to get these liners in, traverse top carriage to left as far as it will go. Then place liner in position and clamp it to top carriage with a 4-inch C-clamp. Traverse top carriage to right, and liner will travel in with top carriage. Install liner on right side in same manner. Line up holes in liners and bottom carriage, place seal in position, and secure with screws and washers after putting COMPOUND, rust-preventive, light, on screw threads (fig. 33).

k. Install Telescope Mount and Quadrant Mount.

(1) Coat threads of four telescope mount bracket screws and dowel pin with COMPOUND, rust-preventive, light. Tap telescope mount and bracket (fig. 31) into position on left trunnion pin. Secure in position with four screws and washers.

(2) Coat the three quadrant mount retaining screws and two dowel pins with COMPOUND, rust-preventive, light. Tap the quadrant mount lightly into position on right trunnion pin. Secure with three screws and washers (fig. 30).

l. Drain Oil from Equilibrators.

(1) When Method 1, paragraphs 27 and 118, is used to remove and mount the equilibrators, it will be necessary to drain oil from equilibrators after howitzer or gun is completely assembled.

(2) Connect the drain tube B291710 (fig. 18) to one equilibrator and the flexible hose B221731 (or copper tube) to the other equilibrator. Insert the free ends of the drain tube and flexible hose into containers which have a capacity of 2½ gallons or more. Elevate the gun (or howitzer) to the maximum elevation, thereby forcing oil from the equilibrators. After the flow of oil has subsided, depress the gun (or howitzer) to approximately horizontal position, and leave in this position until it is observed that no more air is taken in through the drain tube and flexible hose. Again elevate the gun (or howitzer) to the maximum elevation to drain off the rest of the oil. Air will be forced out at the end of this operation which will give proof that no oil remains in the equilibrators. Remove the adapter B291711, drain tube B291710, and flexible hose B221731. Replace the lower plugs A19611 in the rear equilibrator heads.

NOTE: If a new equilibrator is to be assembled to the gun (or howitzer) while in the *traveling position*, extend the equilibrator to

ASSEMBLY OF HOWITZER (OR GUN) AND CARRIAGE

the proper length by forcing oil into the equilibrator as described in paragraph 27 b (3). Close adapter valve A338492. Mount the front end of the equilibrator in its bracket on the cradle, and secure in place with washer A19590, nut BBEX2E, and cotter pin BFAX2CE. Re-assemble the oil pump to the adapter and add sufficient oil to allow assembly of the equilibrator connecting shaft. Install the shaft B105203, washer BECX2W, and nut BBDX3B.

120. PUT MATERIEL IN TRAVELING POSITION.

a. Connect Heavy Carriage Limber M2.

(1) Using a crane and heavy cable sling, lift the trails and swing them into closed position but resting on a wood block 4 feet x 10½ inches high x 8 inches wide. Place block under trails just below air coupling.

(2) Move heavy carriage limber assembly into position at rear of trails with limber lifting mechanism screw between lock plates on trails.

(3) Make certain that the two limber locking pins are in the unlocked position and guide arms on limber are in position over the guides on trails.

(4) Run the limber down by turning handle of limber lifting mechanism until guide arms are in guides and locking pins can be placed in the locked position.

(5) Lock the drawbar in the locked position and lower drawbar prop.

(6) Lower the limber lifting mechanism lock and secure in place with locking pin. Replace cover over limber lifting mechanism and tie to handle.

(7) Remove dummy couplings from air hose couplings and place in their respective brackets on trails.

(8) Connect air hoses from limber to couplings on trails.

b. Mount 155-mm Gun Traveling Lock.

NOTE: The following procedure, steps (1) through (3) below, are not required to place 8-inch howitzer materiel in traveling position (NOTE, par. 25 c).

(1) Place gun traveling lock in position over brackets on trails. Lock in position with spade keys and key retaining pins.

(2) Attach traveling lock cable clevis to bracket on rear of bottom carriage. Secure clevis pin with cotter pin.

(3) Remove cotter pins, nuts, and washers from counterrecoil and recoil piston rod ends. Pull barrel assembly to rear and lock it securely in place on traveling lock with locking pin B108153.

c. Replace spades, bogie lifting screw ratchet wrenches, rammer staff sections, and traveling covers.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

Section XXIV

HEAVY CARRIAGE LIMBER M2

	Paragraph
General	121
Disassemble limber	122
Maintenance and repair	123
Assemble limber	124
Test and adjustment of limber	125

121. GENERAL.

a. Information of a general descriptive and operational nature is contained in section V, TM 9-335 and section XII, TM 9-350.

b. Procedures for removal and installation of heavy carriage limber are covered in paragraphs 25 d and 120 a.

c. **Differences Among Modifications of Heavy Carriage Limber M2.** The limber described and illustrated in this section has the type A limber lifting mechanism. (List of All Parts, SNL D-29, dated 22 May 1943, and SNL D-24, dated 12 June 1943). Later modifications differ from that described in this section chiefly as follows:

(1) The limber lifting mechanism lock assembly and handwheel A174254 will be replaced by limber lifting mechanism nut cover B221416.

(2) Center screw B167009 will be replaced by screw C73299.

(3) Locking pin B166603 will be replaced by pin B221073 and a set screw.

(4) Axle assembly D37524 will be replaced by axle assembly D41497 with lifting screw lock B221414.

(5) Lubrication fittings will be installed on drawbar hinge pins A174265.

(6) New type hose couplings will be used.

122. DISASSEMBLE LIMBER.

a. Remove Limber Lifting Mechanism Center Screw.

(1) Turn hub handle B166602 and insert locking pin B166607 in lower hole of limber lifting mechanism center screw B167009. The limber lifting mechanism lock must be over nut A139100. **NOTE:** This is locked position of limber mechanism used in traveling.

(2) Remove cotter pin BFAX1DX from slotted nut A174251. Remove slotted nut while holding limber lifting mechanism hub handle (fig. 317).

(3) Tap trail supporting pin B166600 off center screw.

HEAVY CARRIAGE LIMBER M2

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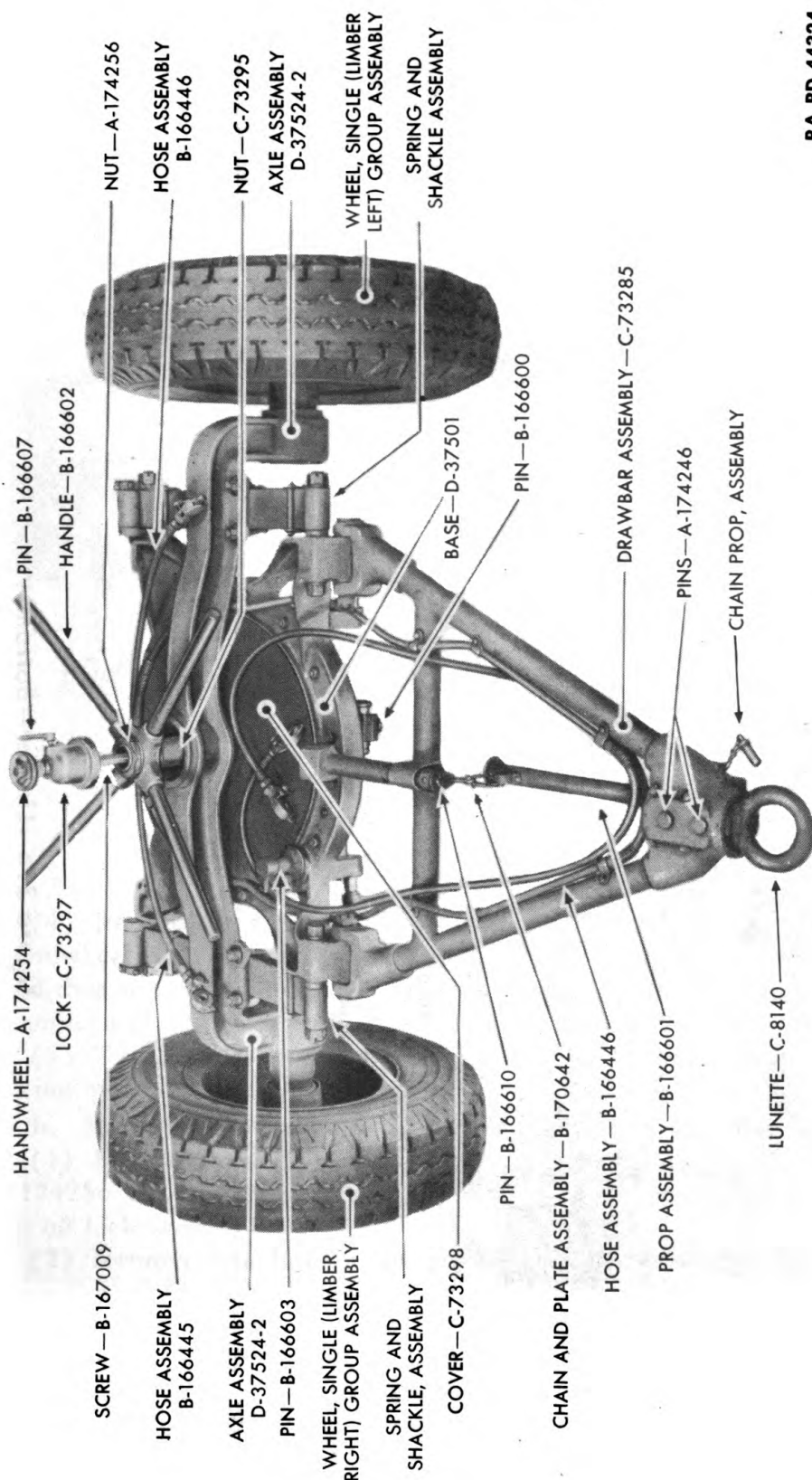


Figure 315—Liber Assembly

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2

- A—HOSE, AIR LINE SERVICE
B—PLATE, TRAIL BASE
RETAINING
C—HANDLE, LIFTING
MECHANISM HUB
D—LOCK, LIFTING
MECHANISM
E—PIN, LOCKING
F—HANDWHEEL, LIFTING
MECHANISM
G—HOSE, AIR LINE
EMERGENCY
H—AXLE ASSEMBLY
J—SPRING, LIMBER
K—SHACKLE, SPRING
L—BASE, TRAIL
M—PIN, TRAIL LOCKING
(LEFT)
N—PIN, TRAIL LOCKING
(RIGHT)
P—PROP ASSEMBLY
Q—NUT, SLOTTED
R—SCREW, CAP
S—CLIP, SPRING
T—CHAIN, PROP,
ASSEMBLY
U—BASE, LIMBER
V—COVER, LIMBER BASE
W—PIN, TRAIL SUPPORTING
X—DRAWBAR ASSEMBLY
Y—PIN, SPRING SHACKLE
Z—SCREW, LIFTING
MECHANISM CENTER

RA PD 44326

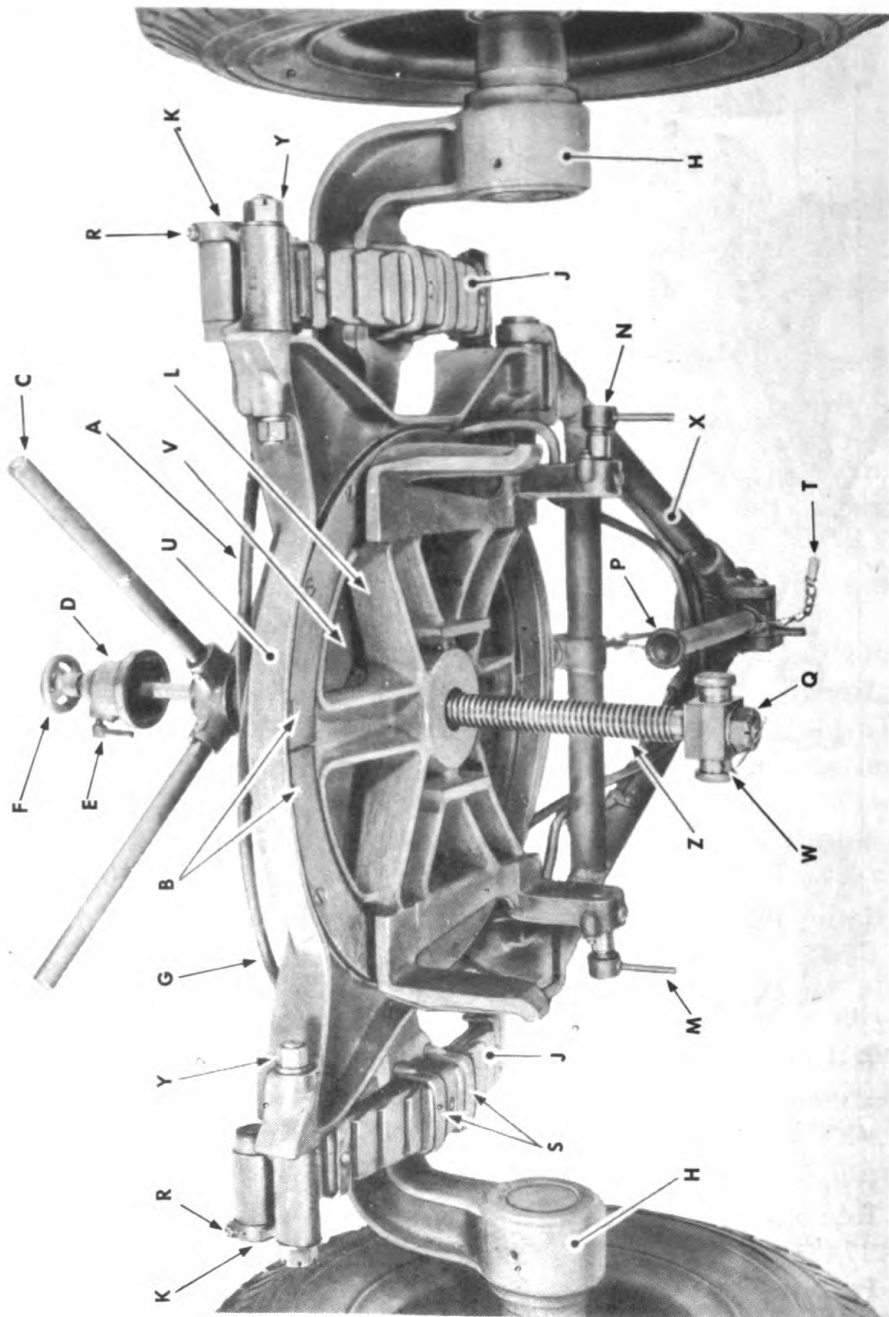
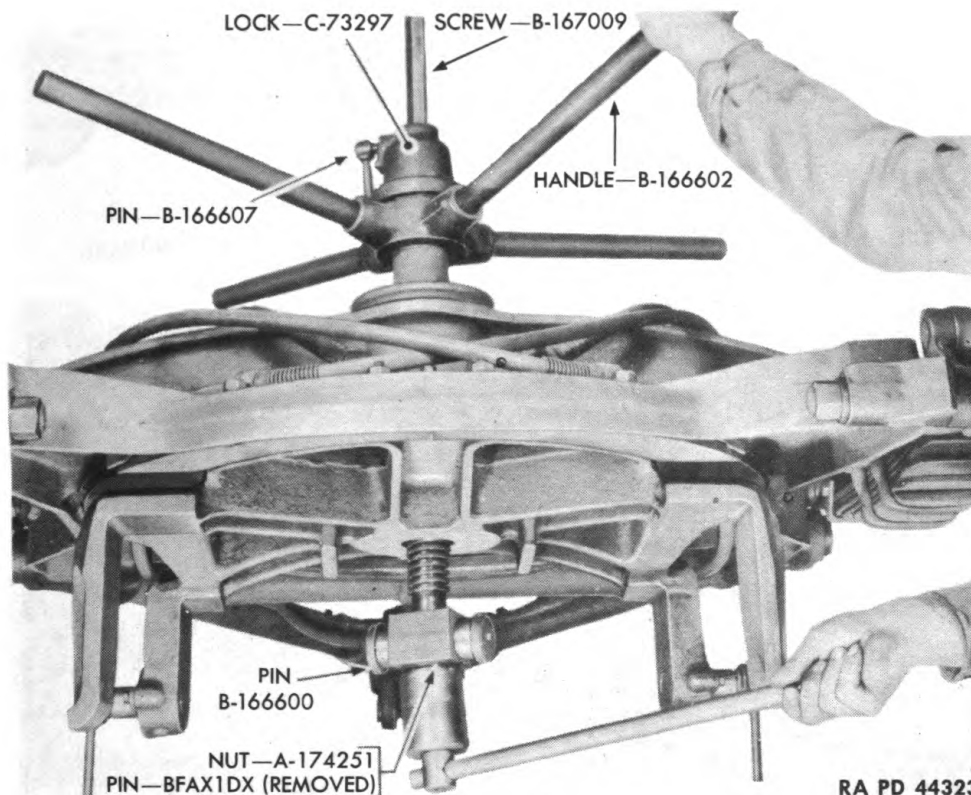


Figure 316—Limber—Bottom View

HEAVY CARRIAGE LIMBER M2



RA PD 44323

Figure 317—Removing Nut from Center Screw

(4) Remove nut A139100 that holds limber lifting mechanism handwheel A174254 on center screw. Lift lock washer off center screw and then tap handwheel off center screw. Slide limber lifting mechanism lock C73297 off center screw.

(5) Turn center screw counterclockwise and remove from limber lifting mechanism nut C73295.

b. Remove Limber Lifting Mechanism Hub Handle.

(1) Flatten turned-up edges of lock washer A174257 so nut A174256 can be turned (fig. 318). Remove the hexagonal nut and lift off lock washer.

(2) Remove four limber lifting mechanism hub handles B166602 from limber lifting mechanism hub C73290 by driving out four pins BFDX2CQ. Tap hub off limber lifting mechanism nut C73295.

c. Remove Lifting Mechanism Lock Locking Pin.

(1) Remove screw BCNX2DE and lock washer that hold lock plate A174255; then lift off lock plate.

(2) Pull locking pin B166607 out of limber lifting mechanism lock C73297. **NOTE:** Locking pin handle is welded on the locking pin.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

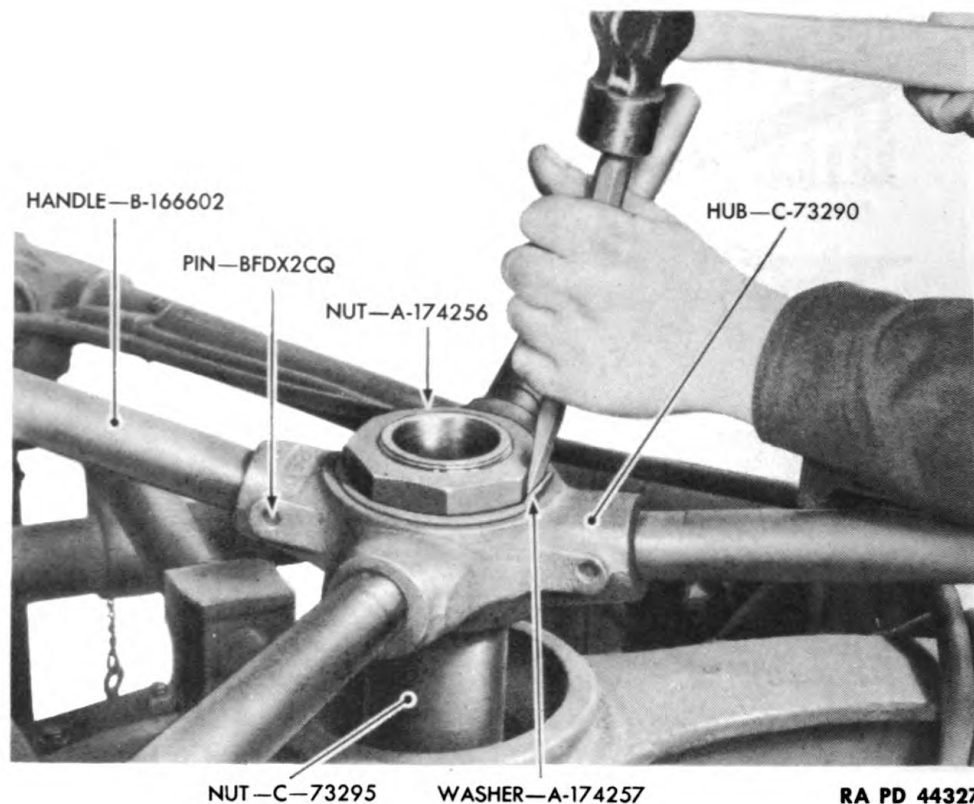


Figure 318—Unfastening Lock Washer

d. Remove Air Line Hoses (fig. 319).

(1) Remove six screws A173454, nuts BBAX1E, and lock washers BECX1M that hold hose straps A174025 and A174030 to limber base D37501.

(2) Remove six screws BCBX5E and washers BEAX1L that hold straps A174026, A174027, and A174068 to drawbar and prop assembly.

(3) Pull air line hose assemblies B166445 and B166446 off limber base and drawbar.

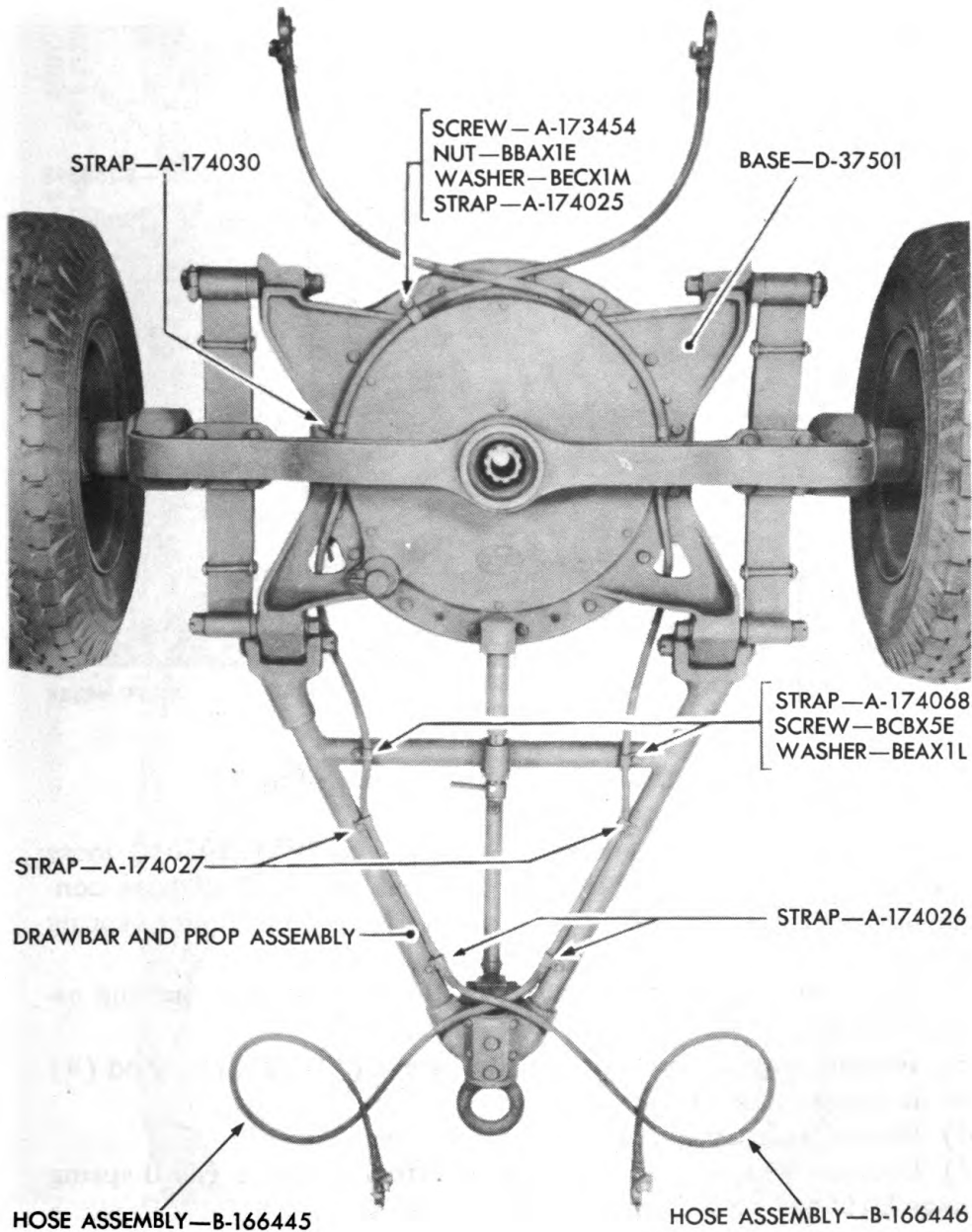
e. Disassemble Air Line Hose Couplings (figs. 320 and 321). Procedures for disassembly of air line service hose assembly B166446 and air line emergency hose assembly B166445 are the same. The following procedure covers the air line service hose:

(1) Clamp service coupling assembly A142611 in a vise and remove hose connector nut BWE-203613 with hose connector spring BWE-201045 from hose connector body BWE-215992.

(2) Remove hose connector body from service coupling assembly.

(3) Pull hose connector gasket BWE-203608 from end of hose

HEAVY CARRIAGE LIMBER M2



RA PD 44415

Figure 319—Air Line Hoses

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

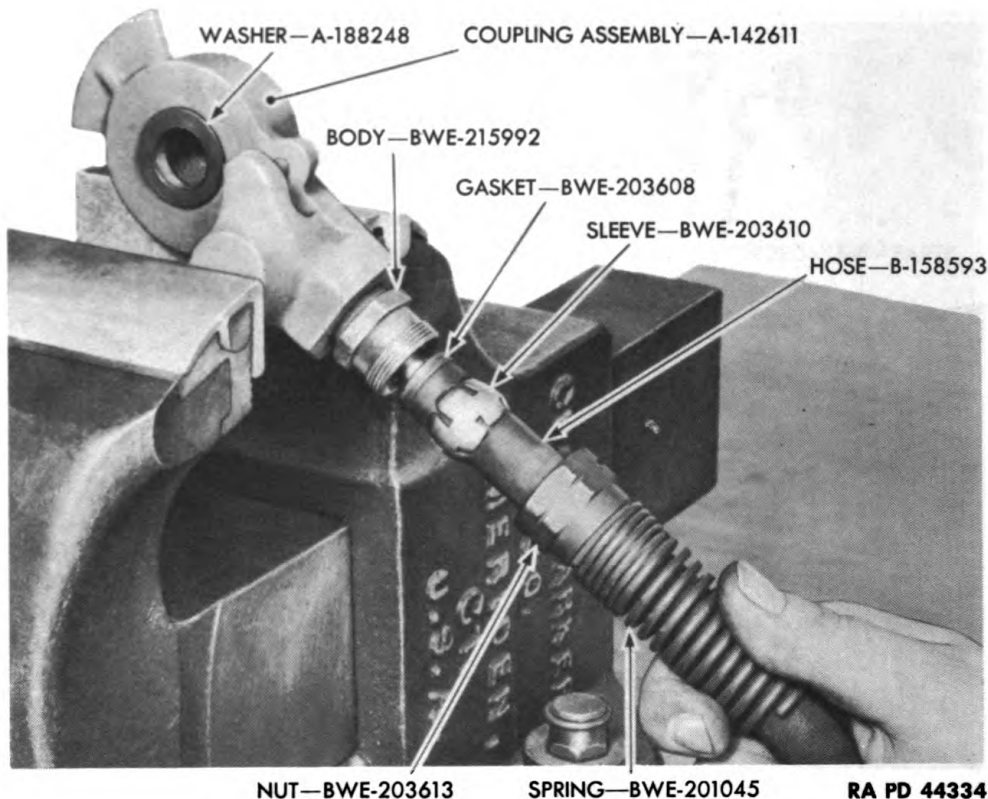


Figure 320—Removing Hose Coupling

B158593. Pry prongs of hose connector sleeve BWE-203610 loose from hose and slide sleeve off hose. Discard sleeve. Pull hose connector nut with hose connector spring from hose and unscrew spring from nut.

(4) Pry hose coupling washer A188248 out of service coupling assembly A142611.

(5) Repeat procedure as described in steps (1), (2), (3), and (4) above at opposite end of air line.

(6) Spread hose straps and pull off air line.

(7) Loosen two hose guard springs A174035 and hose guard spring bushings B166442 on air line with alcohol, and slide off hose. Remove hose guard spring bushings from hose guard springs.

f. Remove Drawbar.

NOTE: Prop assembly should be down and locked, drawbar locking pin in place and locked, and limber on level ground.

(1) Place wood block 27 inches high under front of trail base and block both tires. Place trail base locking pin B166603 in locked position.

HEAVY CARRIAGE LIMBER M2

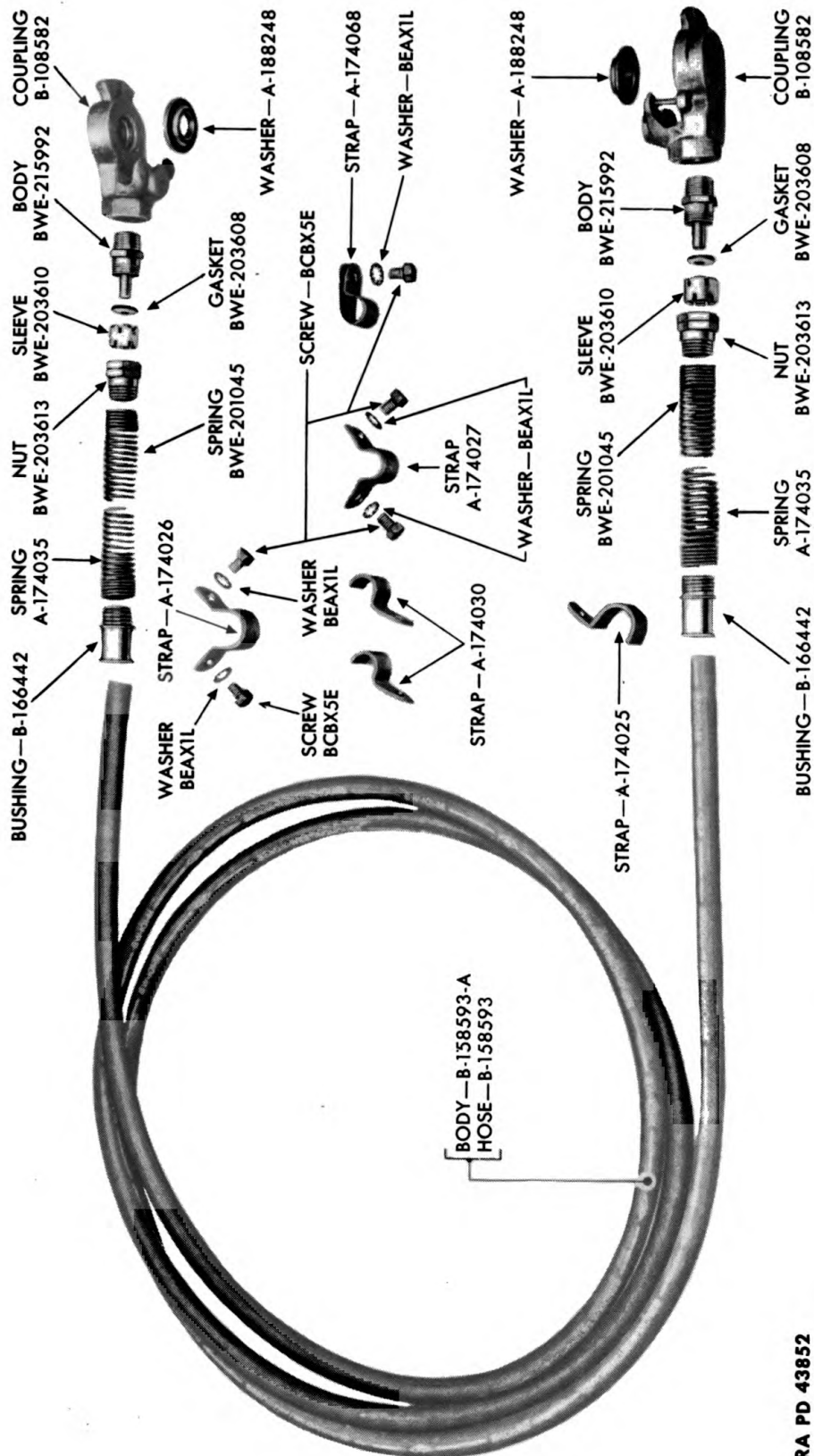
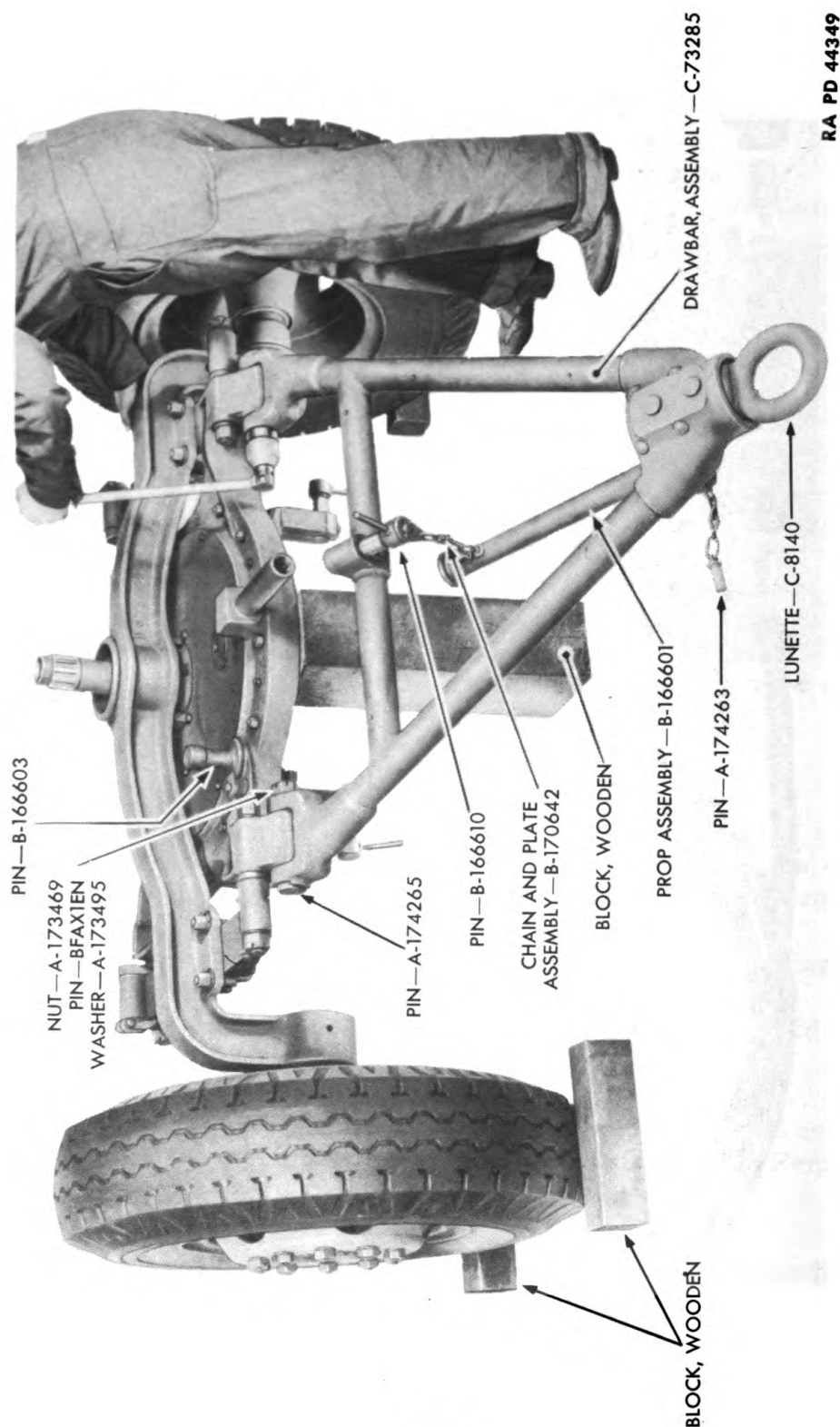


Figure 321—Limber Air Hose and Parts

RA PD 43852

ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2



RA PD 44349

Figure 322 — Removing Drawbar Hinge Pin

HEAVY CARRIAGE LIMBER M2

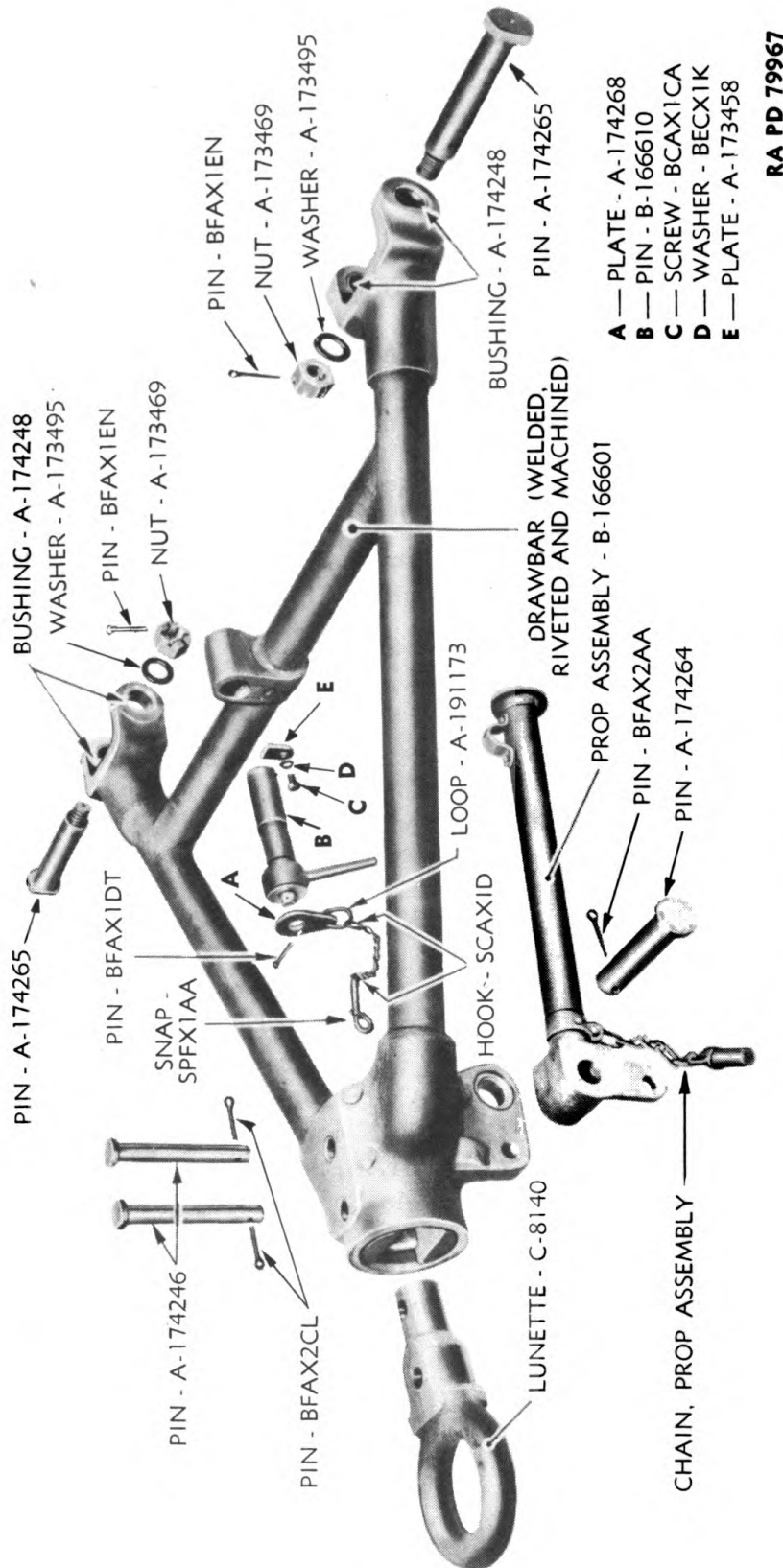


Figure 323—Drawbar Parts

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

(2) Unlock prop assembly by lifting drawbar slightly and pulling out prop chain pin A174263 from drawbar. (Allow prop chain pin to hang on its chain.) Push prop assembly out from under drawbar and lower drawbar until trail base rests on wood block. Attach lower end of prop assembly to chain and plate assembly B170642 (fig. 322).

(3) Turn drawbar locking pin handle up and pull out drawbar locking pin B166610. (It may be necessary to lift slightly on drawbar in order to withdraw pin.) Lower front end of drawbar assembly C73285 onto ground.

(4) Remove cotter pin BFAX1EN from drawbar hinge pin A174265 and then remove nut A173469. Remove plain washer A173495 from drawbar hinge pin and drive pin out of limber base and drawbar.

(5) Pull two oil seals A174267 out of limber base (fig. 333).

(6) Hold or block the drawbar to prevent its falling and repeat operation on opposite drawbar hinge pin. **NOTE:** There are two types of drawbar hinge pins used; one is drilled for lubrication and the other is not.

(7) Lift drawbar assembly C73285 off limber base.

g. Disassemble Drawbar Assembly (fig. 323).

(1) Remove cotter pin BFAX2AA that holds prop hinge pin A174264. Drive prop hinge pin out of drawbar and lift off prop assembly B166601. **NOTE:** Prop foot piece and prop handle are riveted to prop. The chain clamp is riveted to prop, and prop chain B166609 with prop chain pin are riveted to chain clamp.

(2) Remove two cotter pins BFAX2CL that hold two lunette pins A174246 in drawbar. Drive out two lunette pins. Loosen and remove lunette C8140.

(3) Remove cap screw BCAX1CA and lock washer BECX1K that hold locking pin plate A173458 to drawbar.

(4) Remove cotter pin BFAX1DT that holds plate A174268 to drawbar locking pin B166610. Remove chain with loop, hooks SCAX1D, plate and snap SPFX1AA, as a unit. Pull drawbar locking pin out of drawbar. **NOTE:** Field Service Modification Work Order D24-W13, dated 19 July 1943, requires that attachment plate A174268 be welded to face of drawbar locking pin B166610. When this modification is effected, step (4) will be: Pull drawbar locking pin B166610 with chain and plate assembly B170642 out of drawbar.

(5) Press four bushings A174248 out of drawbar.

h. Remove Axle Assembly (fig. 324).

(1) Both wheels must be blocked and limber base supported. Attach chain hoist around axle.

(2) Remove eight nuts A173466 and lock washers BECX3R that hold limber spring clips B166597 to axle assembly D37524-2.

HEAVY CARRIAGE LIMBER M2

RA PD 44330

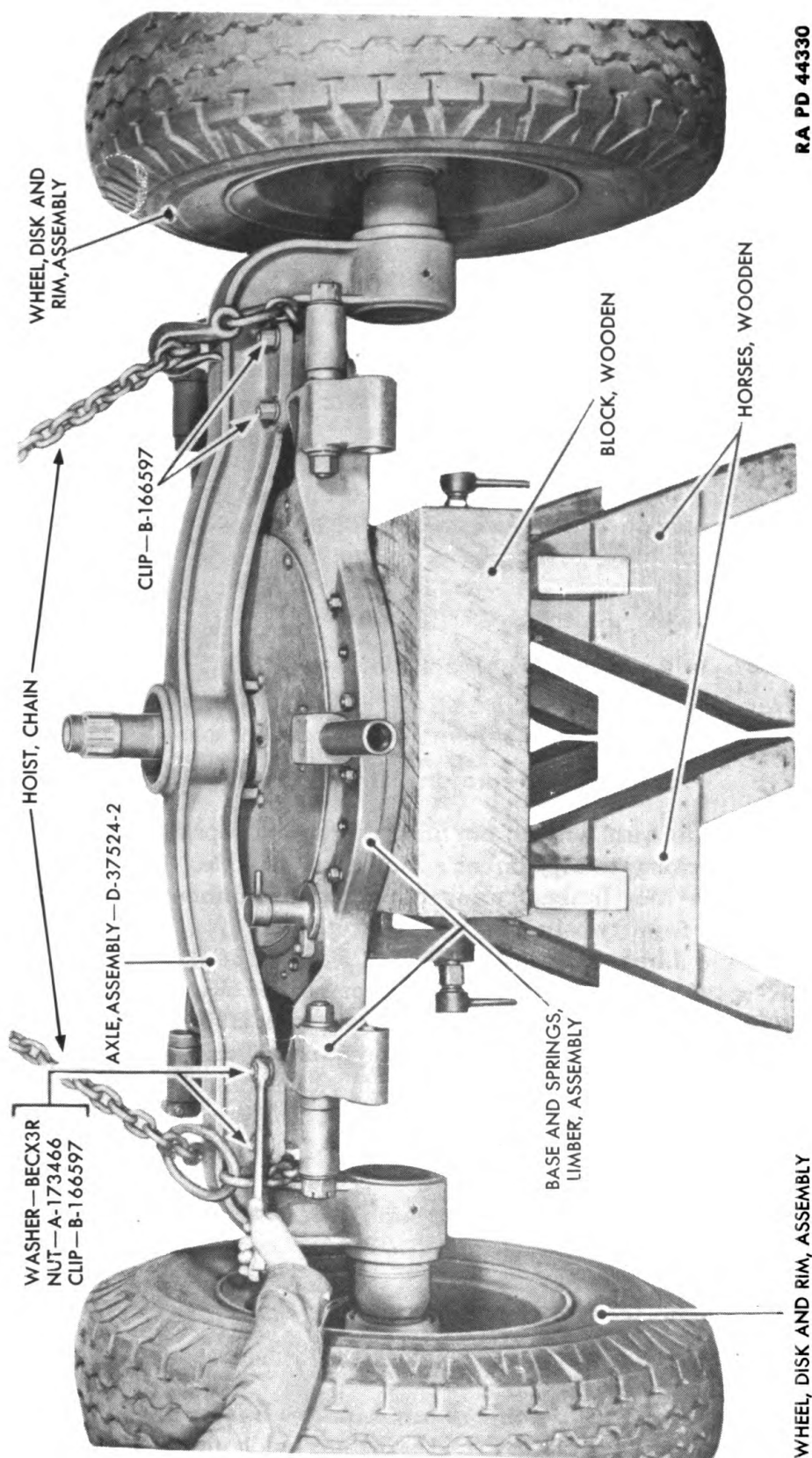


Figure 324 — Removing Axle Assembly from Limber Base

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

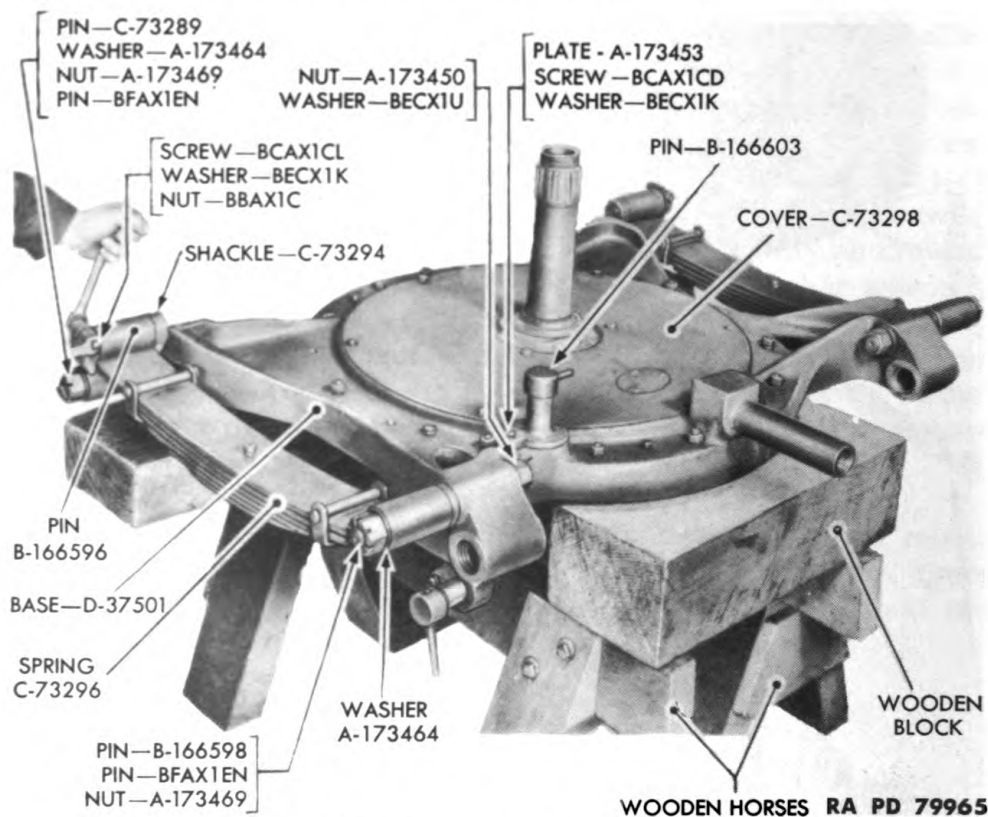


Figure 325—Removing Limber Springs

(3) Lift axle, with wheels, off limber base and springs assembly. It may be necessary to tap limber spring clips off axle.

(4) Remove four limber spring clips and two limber spring clip plates C72900 from two limber springs (fig. 336).

i. Remove Limber Springs (figs. 325 and 336).

(1) Remove nut BBAX1C, lock washer BECX1K, and cap screw BCAX1CL, that hold limber spring shackle pin B166596 in spring shackle C73294 (figs. 325 and 336). Drive limber spring shackle pin out of shackle and limber spring C73296.

(2) Remove cotter pin BFAX1EN that holds nut A173469 on spring attachment pin B166598, then remove slotted nut and lift off washer A173464.

(3) Pull limber spring off limber base D37501 and remove four oil seals A174270 from eye end of spring. (There are two oil seals at each end of limber spring.) Press bushings out of each eye end of spring, if necessary to replace with new bushings.

(4) Repeat procedure as described in steps (1), (2), and (3) above to remove opposite limber spring.

j. Remove Spring Shackle from Limber Base (fig. 325).

(1) Remove cotter pin BFAX1EN that holds nut A173469 on

HEAVY CARRIAGE LIMBER M2

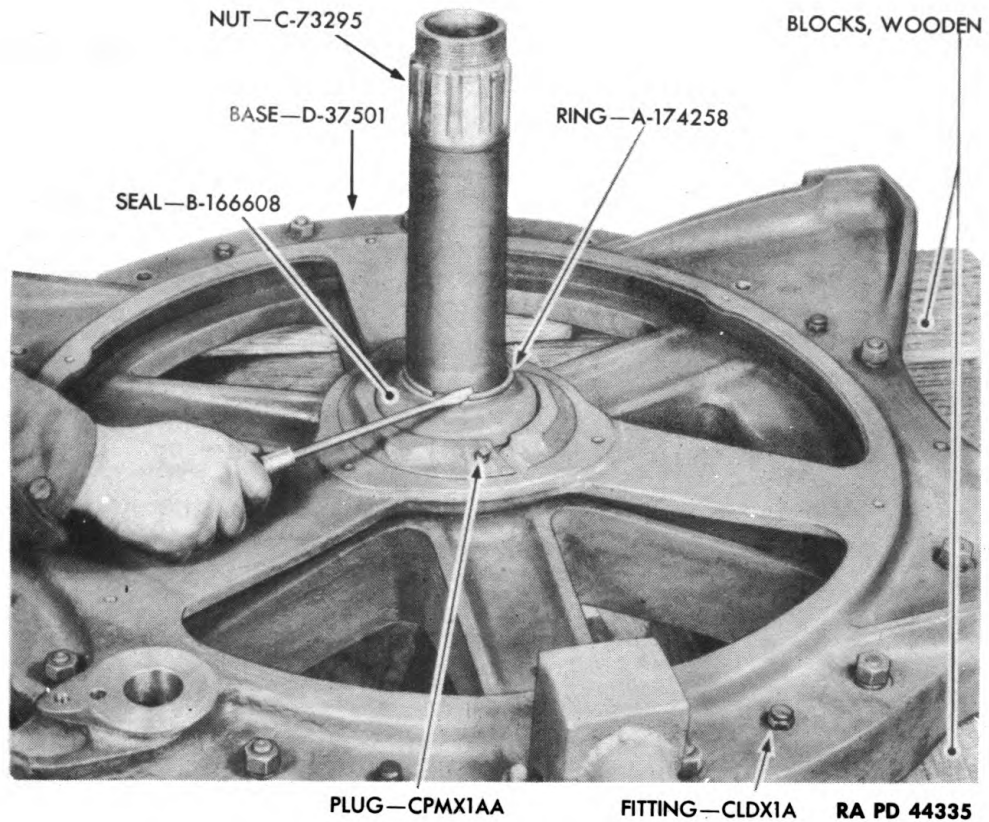


Figure 326—Removing Oil Seal Lock Ring

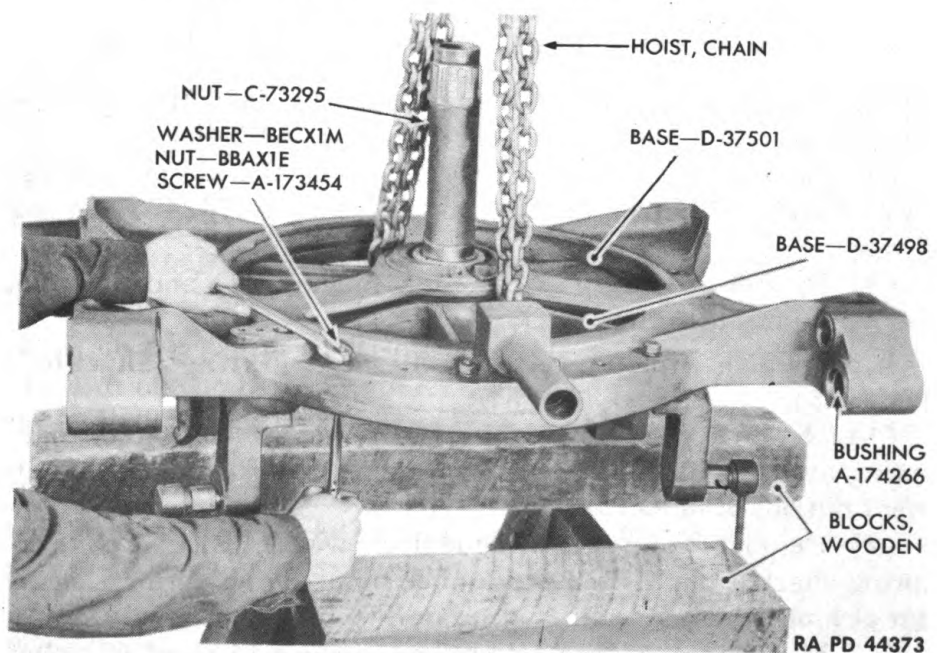


Figure 327—Removing Limber Base Screws

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

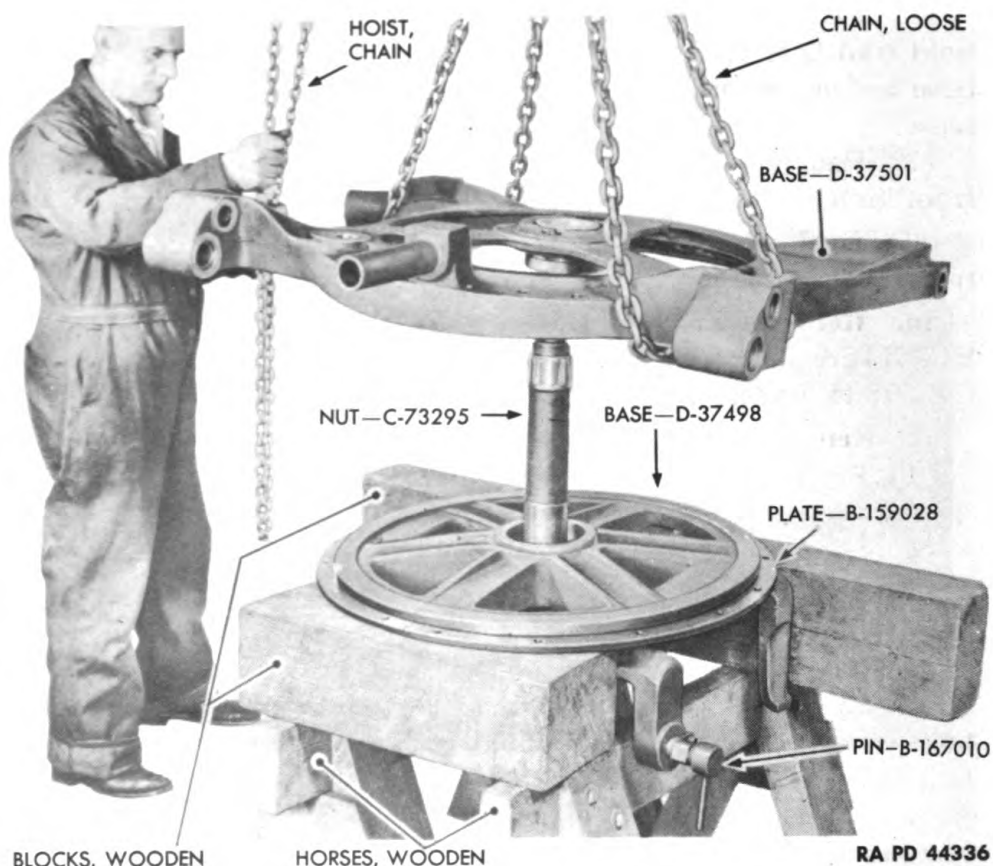


Figure 328—Lifting Limber Base Off Trail Base

spring shackle pin C73289. Remove nut A173469 that holds spring shackle pin on limber base and lift off washer A173464.

(2) Lift spring shackle C73294 off spring shackle pin and remove two oil seals A174270. Press shackle bushing A174247 from shackle, if worn.

(3) Repeat procedure as described in steps (1) and (2) above to remove opposite spring shackle.

k. Remove Spring Attachment and Spring Shackle Pins (fig. 325).

(1) Remove nut A173450 and lock washer BECX1U that hold spring attachment pin B166598 to limber base. Drive spring attachment pin out of limber D37501.

(2) Remove nut A173450 and lock washer BECX1U that hold spring shackle pin C73289 to limber base. Drive spring shackle pin out of limber base.

(3) Repeat procedure as described in steps (1) and (2) above to remove opposite spring attachment and spring shackle pins.

HEAVY CARRIAGE LIMBER M2**l. Remove Trail Base Locking Pin (figs. 325 and 333).**

(1) Remove cap screw BCAX1CD and lock washer BECX1K that hold trail base locking pin plate A173453 to limber base. Lift trail base locking pin plate and trail base locking pin B166603 off limber base.

(2) Remove ball CCAX1E and trail base lock spring A173470 from limber base (fig. 333).

NOTE: Limbers with serial number 665 or higher, do not have a trail base locking pin B166603.

m. Remove Limber Base Cover. Remove nine cap screws BCAX1CA and lock washers BECX1K that hold limber base cover C73298 to limber base. Lift limber base cover off limber base.

n. Remove Oil Seal Lock Ring (figs. 326 and 333).

(1) Pry out lock ring A174258 and slide lock ring and oil seal retaining washer A174259 off limber lifting mechanism nut C73295.

(2) Slide seal B166608 from limber lifting mechanism nut, and lift seal lower washer A187686 from nut (fig. 333).

o. Remove Limber Base.

(1) Install chain hoist on limber and trail bases and raise them off the wood blocks so that all screws are accessible. (**NOTE:** If chain hoist is not available, use suitable rigging and a crane.) Trail base retaining plate will drop slightly but should not be removed at this time. Remove remaining ten screws A173454, nuts BBAX1E, and lock washers BECX1M that hold limber base D37501 to trail base D37498 (fig. 327). (Six screws, nuts, and washers were removed when hose straps A174025 and A174030 were removed.)

(2) Lower limber and trail bases onto wood blocks. Remove six lubrication fittings CLDX1A from limber base. Remove pipe plug CPMX1AA from limber base.

(3) Lift limber base off trail base and over limber lifting mechanism nut (fig. 328).

(4) Press four drawbar hinge pin bushings A174266, if worn, out of limber base (fig. 327).

p. Remove Limber Lifting Mechanism Nut (fig. 329).

(1) Lift out limber lifting mechanism nut C73295 with upper race of thrust ball bearing (light press fit on nut); then tap upper race off nut.

(2) Lift thrust ball bearing cage and thrust ball bearing lower race of bearing CAFX8AU out of trail base. **NOTE:** Thrust ball bearing lower race is beveled to fit the bevel in trail base.

q. Remove Trail Base Retaining Plate (figs. 328 and 333).

Pull two halves of trail base retaining plate B159028 out from under trail base.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

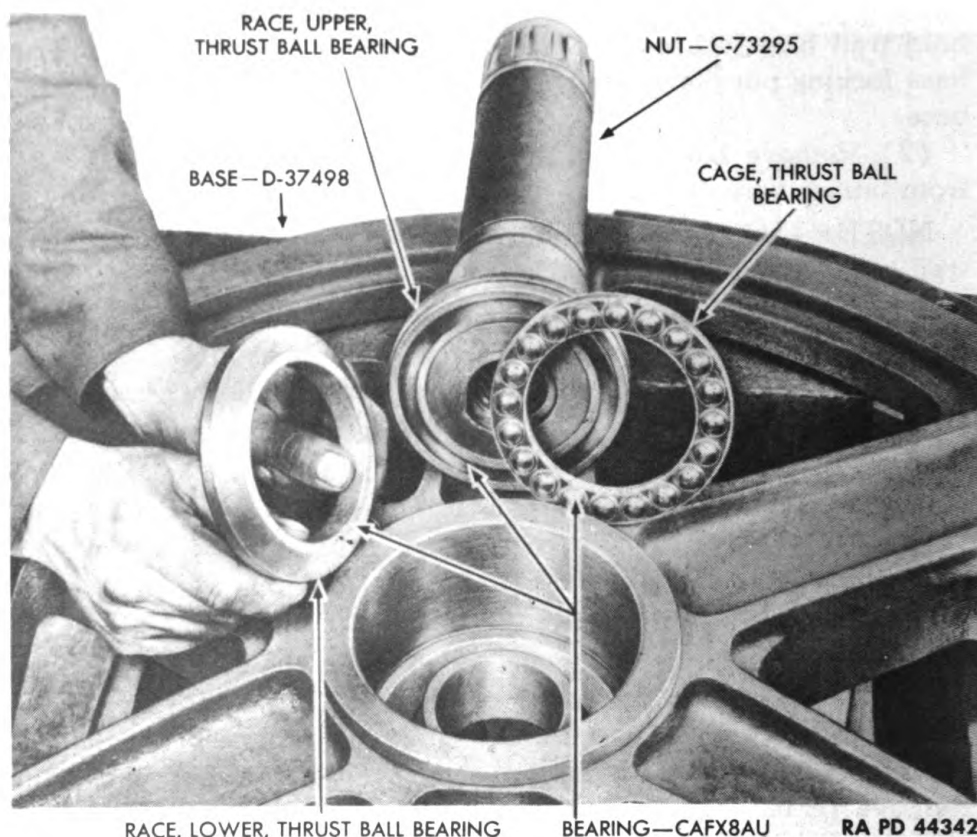


Figure 329—Removing Limber Lifting Mechanism Nut

r. Remove Trail Locking Pins (fig. 333).

NOTE: There are two trail locking pins B167010 and B167011; and the procedure for removal is the same. The following procedure covers removal of one trail locking pin:

(1) Remove screw BCAX1CB and lock washer BECX1K that hold locking pin plate A173458 to trail base and lift off locking pin plate.

(2) Pull trail locking pin out of trail base. **NOTE:** Handle is welded to trail locking pin.

s. Remove Wheels and Hubs (fig. 330). The procedure for removal of limber disk and rim wheels and hubs is similar to that for bogie outer wheels and hubs. Note, however, that mounting of studs and cap nuts is opposite to that for bogie wheels. In the limber, right-hand threads are used on right side, and left-hand threads are used on left side. Cap nuts and wheel studs are marked "R" or "L."

t. Disassemble Hub.

(1) Remove oil retainer B166564 (inner), taper roller bearing

HEAVY CARRIAGE LIMBER M2

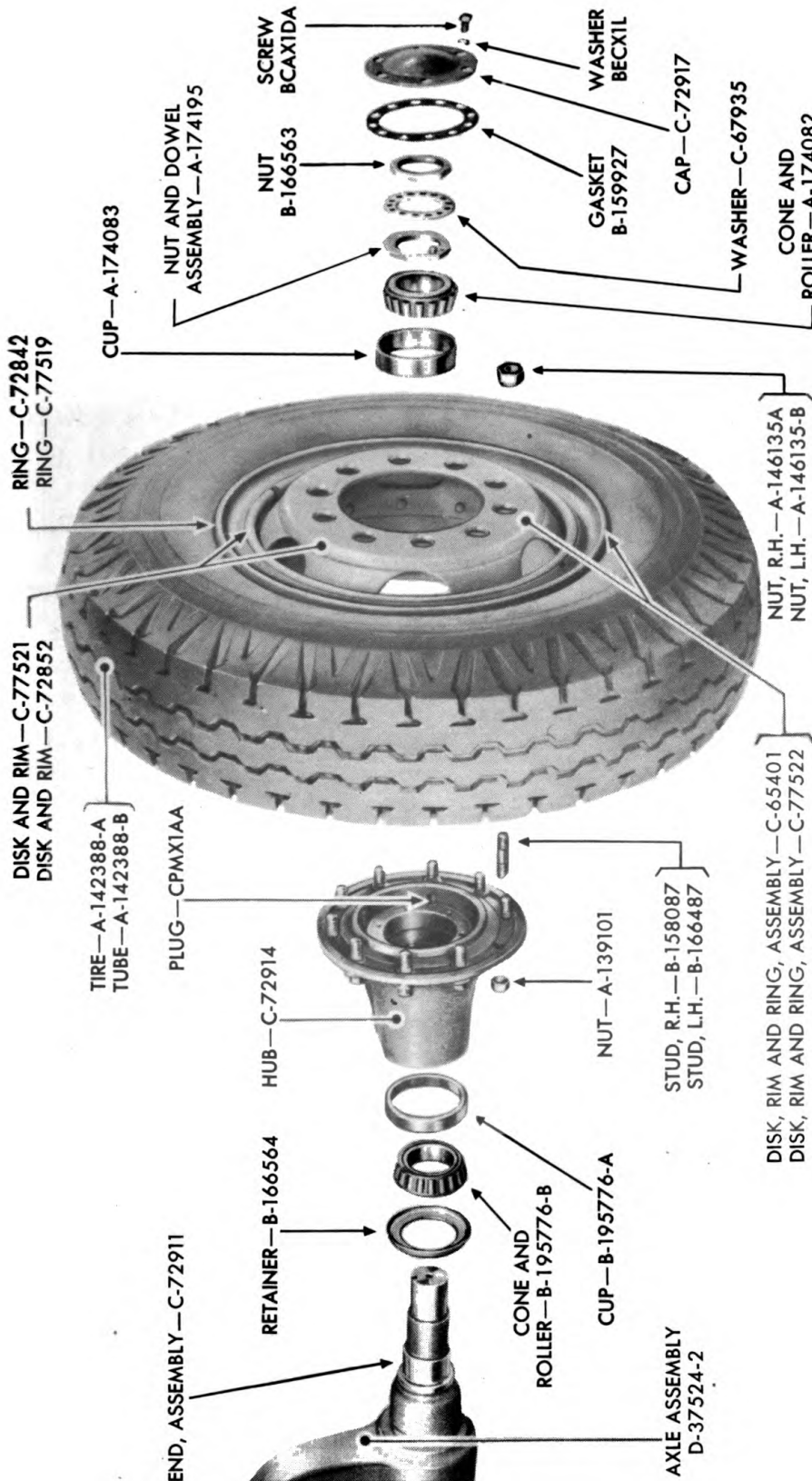


Figure 330—Wheel, Hub, and Bearings—Exploded View

RA PD 43860

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

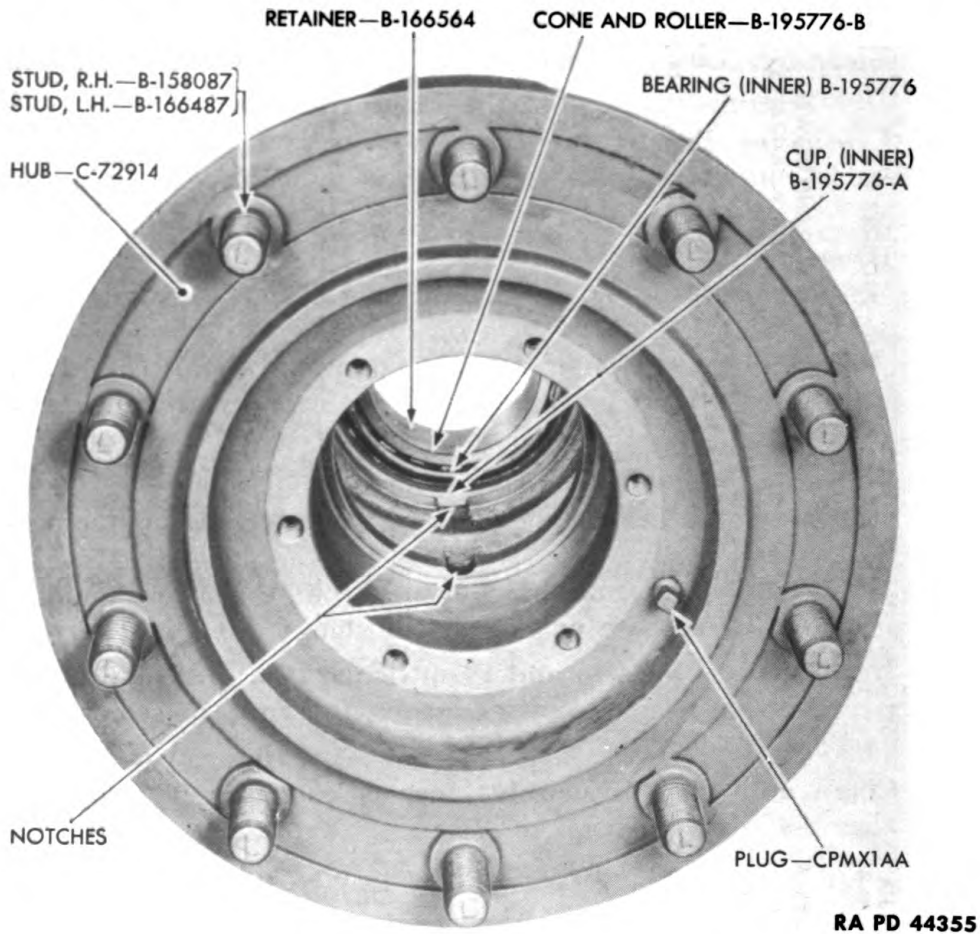


Figure 331—Notches in Wheel Hub

cone and roller B195776B, and (inner) taper roller bearing cup B195776A in one operation, by placing soft drift in notch in wheel hub and driving with hammer against edge of (inner) taper roller bearing cup (fig. 331). Repeat procedure in opposite notch in wheel hub. Drive alternately in each notch until oil retainer, taper roller bearing cone and roller (inner), and taper roller bearing cup (inner) are removed.

(2) Remove pipe plug CPMX1AA.

(3) Turn wheel hub upside down and remove taper roller bearing cup (outer), using same procedure as described in step (1) above.

(4) Remove hexagonal nuts A139101 that hold wheel studs B158087 or B166487 to hub and drive studs out of hub.

(5) Repeat procedure as described in steps (1), (2), (3), and (4) above to disassemble opposite wheel hub.

(6) Lower axle to ground.

HEAVY CARRIAGE LIMBER M2

123. MAINTENANCE AND REPAIR.

a. **Cleaning.** Clean all parts with SOLVENT, dry-cleaning, and BRUSH, grease, bristled.

b. **Cracks or Fractures.** Visually inspect all metal parts for cracks or fractures. Examine welds for breaks. Replace all damaged parts.

c. **Drawbar.**

(1) Inspect drawbar for cracks or fractures and weld any minor breaks.

(2) Install lunette in filler (front end of drawbar) (fig. 323). Lunette must be a tight fit in filler; if it is not, replace lunette or drawbar, or both.

d. **Drawbar Hinge Pin and Bushing.**

(1) Inspect two drawbar hinge pins for scores, cracks, or fractures. Replace a defective pin.

(2) Slide two bushings on drawbar hinge pin. Bushings should be snug fit on pin; if they are not, replace bushings.

e. **Drawbar Locking Pin and Prop Hinge Pin.** Inspect drawbar locking pin and prop hinge pin for cracks, fractures, or scores. Replace a defective pin.

f. **Chain and Plate Assembly.** Inspect condition of chain and plate assembly. Replace if broken.

g. **Lunette.** Inspect lunette for cracks or fractures. Replace a cracked or fractured lunette.

h. **Prop Assembly and Prop Chain Assembly.** Inspect condition of prop assembly, including prop chain assembly. Replace badly worn or damaged chain and parts with new parts.

i. **Lunette Pins.** Inspect two lunette pins for scores. Replace badly scored pins with new pins.

j. **Limber Springs.** Inspect two limber springs for broken leaves or worn bushings. Replace spring that has broken spring leaves. Replace worn bushing with new bushings.

k. **Limber Base and Trail Base.** Inspect limber base and trail base for cracks or fractures. Replace a cracked or fractured limber base or trail base.

l. **Shackle Bushings.** Install two spring shackle pins in two shackle bushings, and if there is any looseness of the pins in the bushings, replace bushings.

m. **Limber Spring Clips.**

(1) Examine four limber spring clips for damage. Replace a damaged clip if found.

(2) Inspect threads; if badly damaged, replace clips.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

n. Limber Spring Clip Plates. Inspect two limber spring clip plates for cracks or fractures. Replace a cracked or fractured plate.

o. Spring Shackles. Inspect two spring shackles for cracks or fractures. Replace defective shackles.

p. Limber Spring Shackle Pin, Spring Shackle Pin, and Spring Attachment Pins.

(1) Examine two limber spring shackle pins B166596 for wear, damage, or scoring, and if any of these conditions is found, replace with new pins.

(2) Examine two spring attachment pins B166598 for wear, damage, or scoring. If any of these conditions is found, replace pins.

(3) Inspect spring shackle pins C73289 as described in step (2) above.

q. Oil Seals. It is always advisable to replace oil seals and not use them over again as they are made of cork. If new oil seals are not available and old seals are not cracked or broken, they can be used again.

r. Threads. Inspect all threaded parts for burs or mashed threads, and if found, use new parts. If new parts are not available, straighten up threads with a thread die of correct size.

s. Trail Locking Pins and Trail Base Locking Pin. Inspect for wear, damage, or scoring. Replace worn, damaged, or scored pins.

t. Thrust Ball Bearing. Inspect balls in thrust ball bearing for flat spots or chipping; then inspect races for scoring, and replace thrust ball bearing if any of these conditions is found.

u. Limber Lifting Mechanism Nut.

(1) Install limber lifting mechanism hub on limber lifting mechanism nut, and if there is any looseness, replace hub or nut, or both.

(2) Install thrust ball bearing upper race on limber lifting mechanism nut, and if there is any looseness, replace nut or bearing, or both.

v. Oil Seal Lock Ring and Oil Seal Cup.

(1) Inspect oil seal cup (rubber) for cracks or breaks, and replace a defective cup.

(2) Inspect oil seal lock ring for breaks or bends, and replace a defective ring.

w. Center Screw. Inspect center screw for wear or damage; then inspect threads (subpar. r above). NOTE: Center screw is subject to wear and must be inspected carefully.

x. Limber Lifting Mechanism Lock and Trail Supporting Pin.

(1) Examine limber lifting mechanism lock for wear or damage. Replace when damaged or worn.

(2) Check condition of trail supporting pin B166600. Replace if worn or damaged.

y. Limber Axle (fig. 332). Check condition of axle. If damaged

HEAVY CARRIAGE LIMBER M2

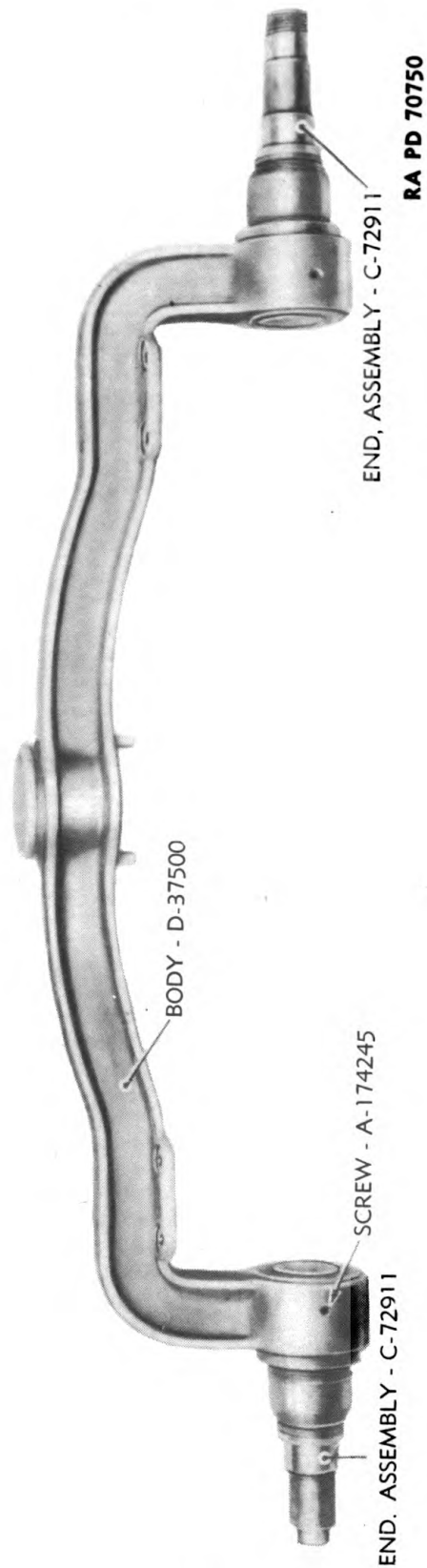
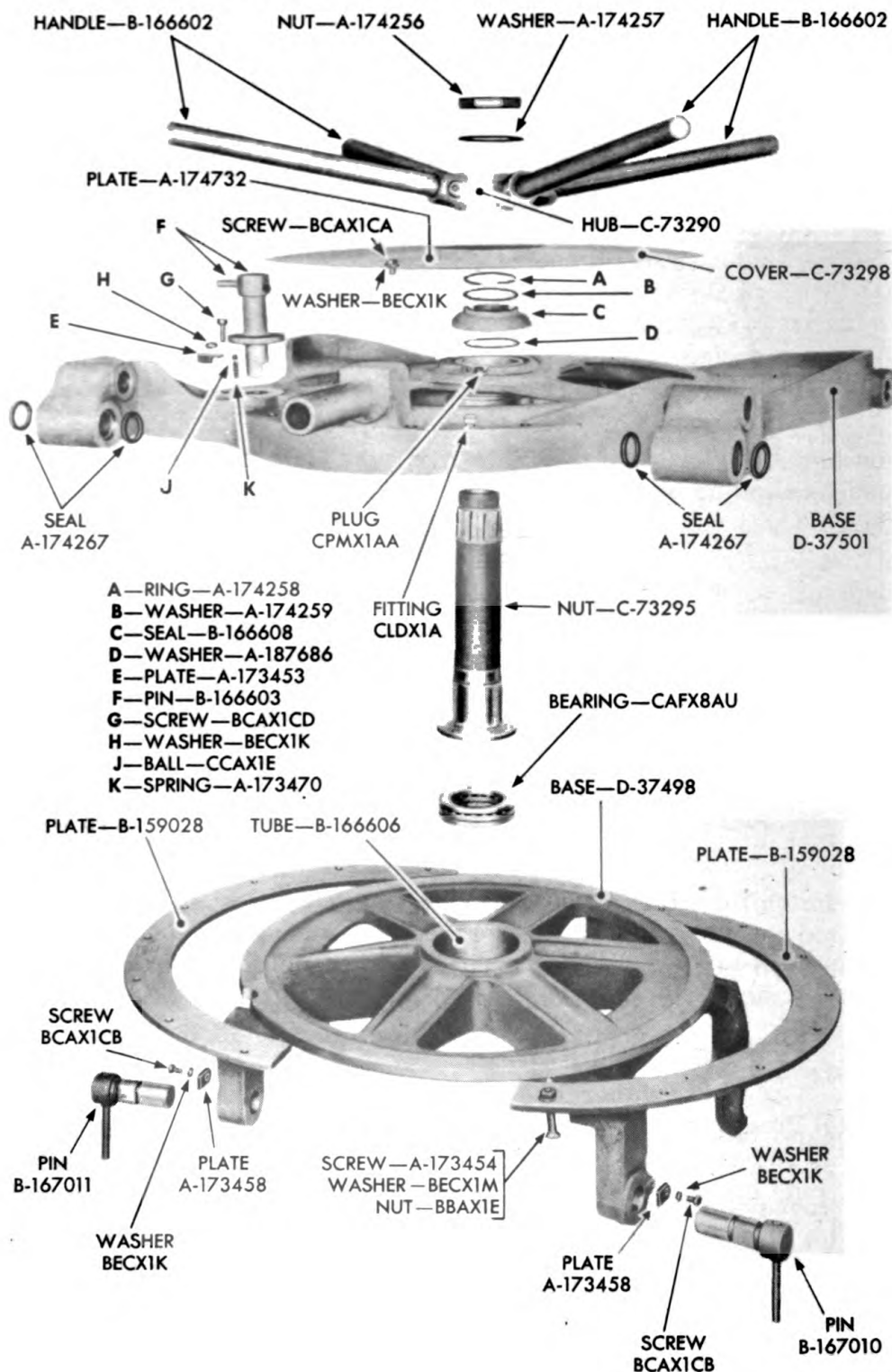


Figure 332—Limber Axle Assembly

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 43887

Figure 333—Limber Base and Trail Base—Exploded View

HEAVY CARRIAGE LIMBER M2

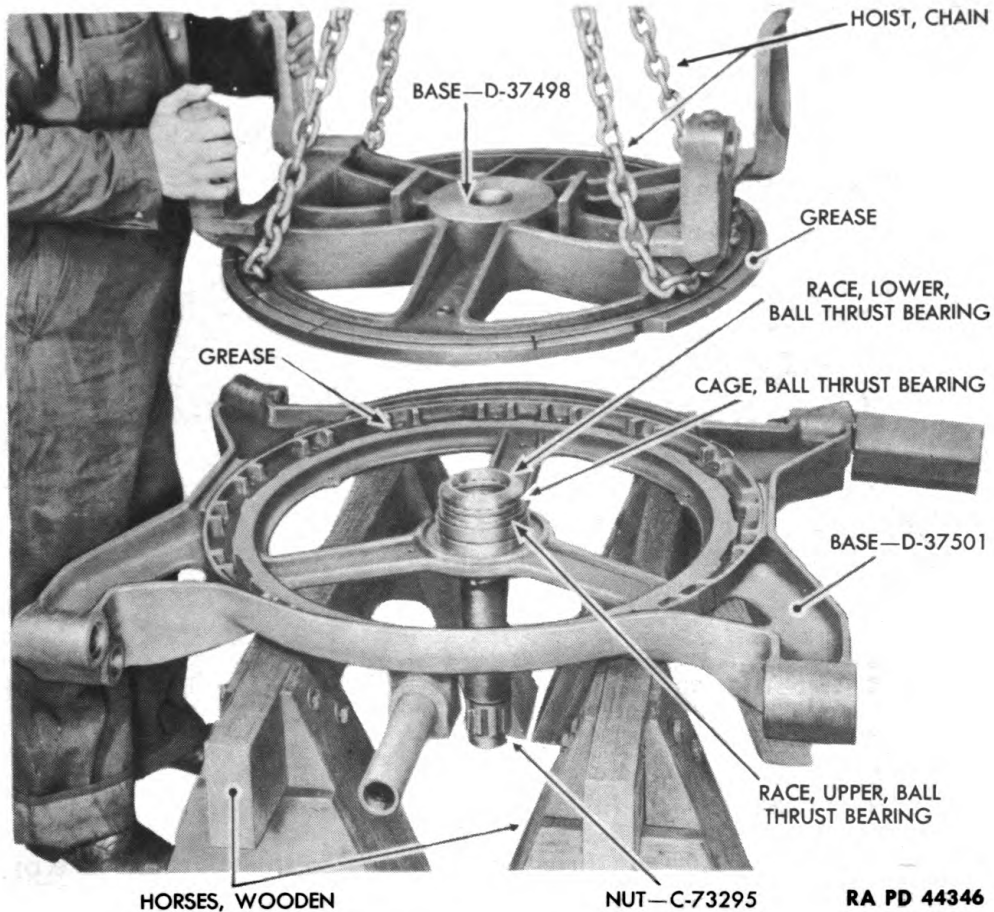


Figure 334—Installing Trail Base

or bent, replace it with a new axle. Check condition of axle ends. If scored or bruised, replace axle.

124. ASSEMBLE LIMBER.

a. Assemble Limber Base.

- (1) Press four drawbar hinge pin bushings in limber base.
- (2) Tap thrust ball bearing upper race on limber lifting mechanism nut; then coat race with **GREASE**, general purpose (seasonal grade).
- (3) Place limber base upside down on two wood horses (fig. 334). Install limber lifting mechanism nut in limber base. Pack thrust ball bearing case with lubricant and install on thrust ball bearing upper race. Coat thrust ball bearing lower race with lubricant and place on thrust ball bearing cage with beveled face up.
- (4) Coat inside edge of limber base with **GREASE**, general purpose (seasonal grade), and lower trail base onto limber base (fig. 334).

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

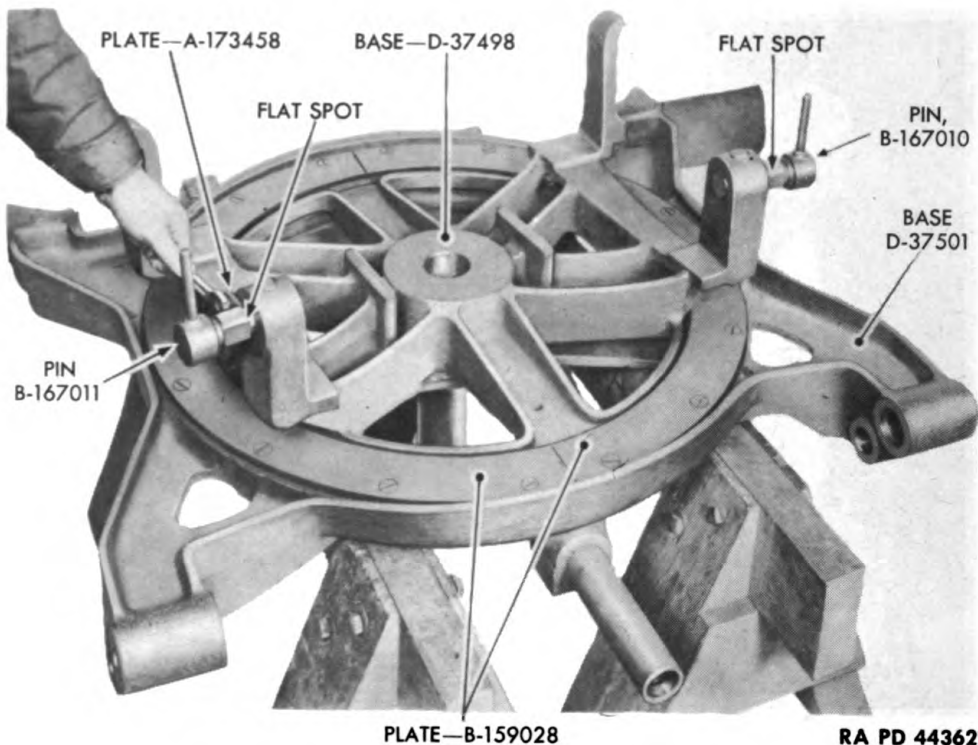


Figure 335—Installing Trail Locking Pins

NOTE: Aline trail base on thrust ball bearing so that beveled face of lower race is seated in beveled part of trail base, and bearing is over trail base center tube.

(5) Install the halves of trail base retaining plate on trail base; then install cap screws through plate and fasten with lock washers and nuts, but do not tighten at this time.

b. Install Trail Locking Pins (fig. 335). There are two trail locking pins, one on right side of trail base and one on left side. Trail locking pins are in locked position when handle points down, and this makes the two pins noninterchangeable. Flat spot on trail locking pin must be away from locking pin plate when the pin is in locked position. Install two trail locking pins in trail base; then install two locking pin plates and fasten with two cap screws and lock washers.

c. Install Cup Oil Seal. Turn limber and trail base assembly over and slide cup oil seal lower washer on limber lifting mechanism nut. Install cup oil seal, oil seal retaining washer, and oil seal lock ring on limber lifting mechanism nut. Seat oil seal lock ring firmly on limber lifting mechanism nut (figs. 326 and 333).

d. Install Trail Base Locking Pin.

(1) Install trail base lock spring and ball in trail base; then install trail base locking pin and trail base locking pin plate.

HEAVY CARRIAGE LIMBER M2

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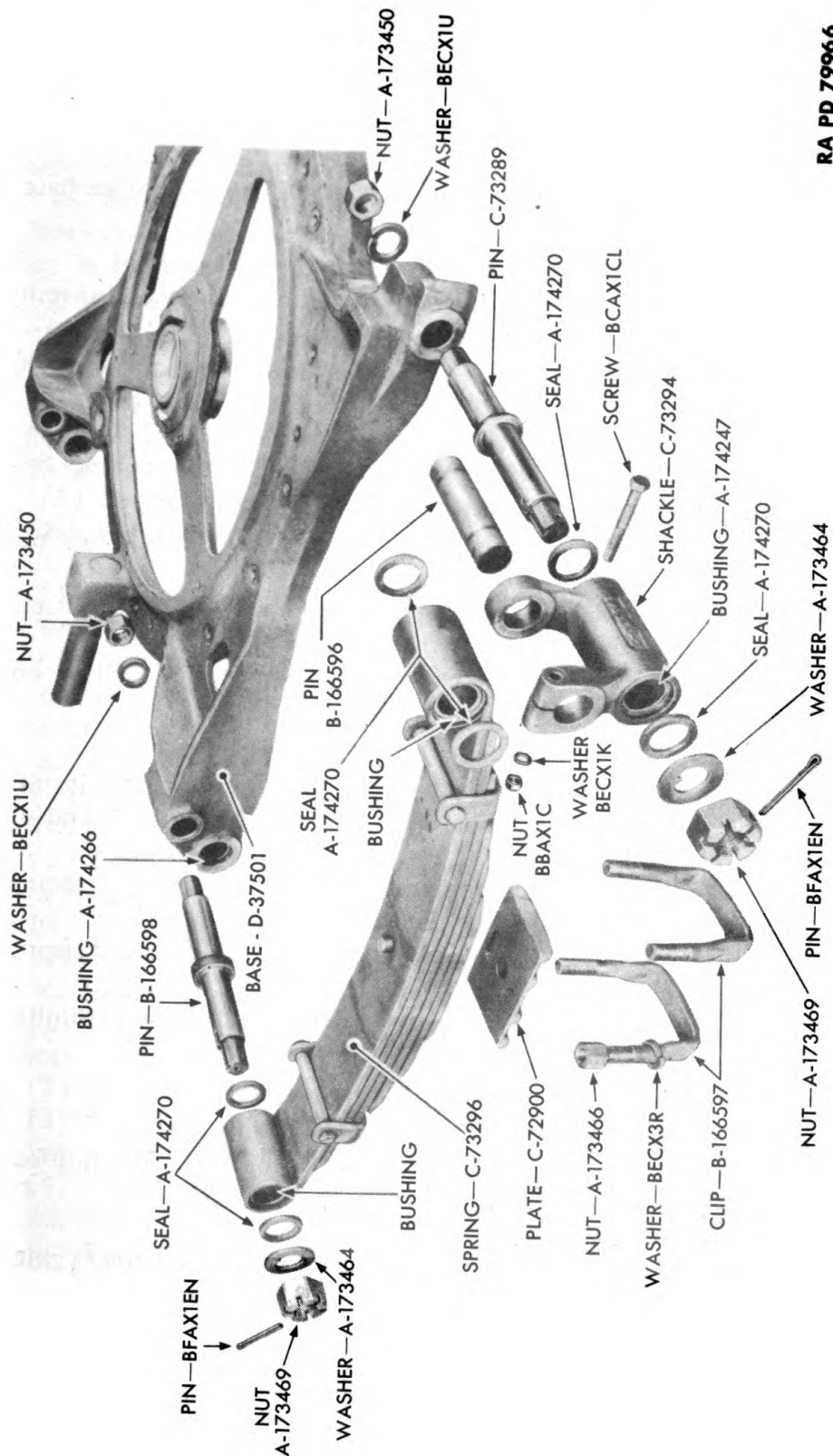


Figure 336—Lumber Spring Parts

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

(2) Install lock washer and cap screw that hold trail base locking pin plate to limber base.

(3) Install pipe plug and six lubrication fittings on limber base.

e. Install Limber Base Cover (fig. 333).

(1) Install limber base cover on limber base.

(2) Install nine cap screws and lock washers that hold limber base cover to limber base.

f. Install Spring Attachment and Spring Shackle Pins.

(1) Drive spring shackle pin C73289 into limber base and install nut and lock washer that hold pin to limber base.

(2) Drive spring attachment pin into limber base and install lock washer and nut that hold pin to limber base.

(3) Repeat procedure as described in steps (1) and (2) above to install opposite spring attachment and spring shackle pins.

g. Install Spring Shackles on Limber Base (fig. 336).

(1) Install shackle bushing in spring shackle, and install two oil seals in shackle.

(2) Install spring shackle on spring shackle pin C73289 and fasten with washer, nut, and cotter pin.

(3) Repeat procedure as described in steps (1) and (2) above on opposite spring shackle.

h. Install Limber Springs.

(1) Install bushings in eye of each end of limber spring, and install oil seals in eye end of spring. (There are two oil seals at each end of spring.)

(2) Install limber spring on limber base and drive limber spring shackle pin B166596 through shackle and spring eye.

(3) Install cap screw, lock washer, and nut that hold limber spring shackle pin in spring shackle.

(4) Install washer, slotted nut, and cotter pin that hold limber spring on spring attachment pin B166598.

i. Assemble Wheel Hubs (fig. 330).

(1) Raise axle to a height that wheels may be installed.

(2) Coat taper roller bearing cup (outer) with **TALLOW**, mutton, refined, or **LEAD**, white, and install cup (outer) in wheel hub.

(3) Install pipe plug in wheel hub.

(4) Lubricate taper roller bearing cone and rollers (inner) with sufficient **GREASE**, general purpose, No. 2, to cover the rollers. Install cone and rollers (inner) in the wheel hub. Coat taper roller bearing cup (inner) with **TALLOW**, mutton, refined, or **LEAD**, white, and install in wheel hub. Then install new oil retainer in wheel hub.

(5) Install disk and rim wheel studs in hub, and install hexagonal nuts on studs.

HEAVY CARRIAGE LIMBER M2

(6) Repeat procedure as described in steps (1), (2), (3), (4), and (5) above on opposite wheel hub.

j. Install Wheel Hubs and Wheels. The procedure for installation of limber disk and rim wheels and hubs is the same as that for bogie outer wheels and hubs (par. 122 s).

k. Adjust Wheel Bearing. Adjust the wheel bearing so that the wheel turns freely, without perceptible shake (par. 72, TM 9-335 or par. 54 b, TM 9-350).

l. Install Limber Base and Springs Assembly.

(1) Raise limber base and springs assembly and, using wood horses or wood blocks, make a support 27 inches high. Lower limber base and spring assembly to support.

(2) Raise axle and wheel assembly, and install it on limber base and springs assembly (fig. 324).

(3) Install limber spring clip plate on each limber spring, then install two limber spring clips on each spring and tap clips through axle.

(4) Install eight lock washers and nuts on two limber spring clips.

m. Install Lifting Mechanism Lock Locking Pin.

(1) Install locking pin in limber lifting mechanism lock, then install locking pin lock plate on lock and fasten with lock washer and screw.

n. Install Limber Lifting Mechanism Hub Handle.

(1) Install four limber lifting mechanism hub handles in hub and fasten with four pins.

(2) Install limber lifting mechanism hub on limber lifting mechanism nut, then install lock washer and hexagonal nut.

(3) Bend edge of lock washer up and against hexagonal nut, so as to hold nut from turning.

o. Install Limber Lifting Mechanism Center Screw.

(1) Turn center screw into limber lifting mechanism, from top of limber.

(2) Slide limber lifting mechanism lock on center screw.

(3) Tap handwheel on center screw. Install lock washer and hexagonal nut on center screw.

(4) Tap trail supporting pin B166600 on lower end of center screw, and fasten with slotted nut and cotter pin.

p. Assemble Drawbar (fig. 323).

(1) Press four bushings (for drawbar hinge pin) into drawbar.

(2) Install drawbar locking pin in drawbar; then install chain and plate assembly (plate, loop, hooks, snap, and chain) on pin and fasten with cotter pin. Install locking pin plate on drawbar and fasten with lock washer and cap screw (NOTE, par. 122 g (4)).

(3) Install lunette and fasten with two lunette pins; then install cotter pin in each lunette pin.

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

(4) Install prop assembly on drawbar and fasten with prop hinge pin and cotter pin.

q. Install Drawbar.

(1) Install four oil seals in limber base and then install drawbar on base.

(2) Drive two drawbar hinge pins through drawbar and limber base, install plain washer; then fasten with nut and cotter pin.

r. Assemble Air Line Hose (fig. 321).

NOTE: There are two limber air hoses to be assembled. Procedure is the same for both. The following procedure covers one hose:

(1) If new limber air hose is being used, it must be cut 14 feet, 5 inches long. The end must be smooth, and at right angles to the outside wall (square cut). Make certain end of hose is not crimped or closed. Blow out the air line with compressed air to remove any dirt or cuttings.

(2) Slide one hose guard spring bushing on each end of hose, then one hose guard spring on each end of bushing.

(3) Slide hose connector spring and hose connector nut on hose. Then slide hose connector sleeve on hose about 1 inch back from end of hose.

(4) Place hose connector gasket over end of hose connector body and remove protective covering from gasket. Install hose on hose connector body and push hose until it is against bottom of recess in hose connector body.

(5) Move hose connector sleeve (installed as described in step (3) above) against edge of hose connector body and tighten hose connector nut (installed as described in step (3) above) on body to a snug fit. **NOTE:** There will be $\frac{1}{8}$ - to $\frac{3}{16}$ -inch clearance between nut and the hexagon on body when nut is properly tightened. Tighten or loosen nut until correct clearance is obtained.

(6) Install hose coupling washer in hose coupling and install hose coupling on body.

8. Install Air Line Hose.

NOTE: If air line hose is being installed on a new drawbar, it will be necessary to drill and tap drawbar so hose straps may be installed ($\frac{27}{64}$ -in. drill and $\frac{1}{2}$ -13 thread tap).

(1) Install air line emergency hose (fig. 319). Install three hose straps on drawbar. Pass hose through limber base and install three hose straps on limber base.

(2) Repeat procedure as described in step (1) above to install air line service hose.

125. TEST AND ADJUSTMENT OF LIMBER.

a. Air Leaks in Air Line Hose. A complete check of air system

HEAVY CARRIAGE LIMBER M2

is necessary (par. 37 g, TM 9-335 and par. 27c, TM 9-350). A complete check of hose and hose fittings must be made frequently.

b. Trail Base. Test trail base for free action by turning base. If binding or hard turning occurs, lubricate (section **XXV**). If trail base continues to turn hard, disassemble (par. 122), clean, and lubricate.

c. Trail Supporting Pin. Install limber on materiel and raise trails. If trail supporting pin does not fit on trails, repair trails or replace pin.

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Section XXV

LUBRICATION

	Paragraph
Introduction	126
Lubrication guide	127
Reports and records	128

126. INTRODUCTION.

a. Lubrication is an essential part of preventive maintenance, determining to a great extent the serviceability of parts and assemblies.

127. LUBRICATION GUIDE.

a. **General.** Lubrication instructions for this materiel are consolidated in lubrication guides (figs. 337 through 340). These specify the points to be lubricated, the periods of lubrication, and the lubricant to be used. In addition to the items on the guide, other small moving parts such as hinges and latches must be lubricated at frequent intervals.

(1) **FITTINGS.** Clean before applying lubricant. Where bearings can be seen, lubricate until new lubricant is forced from the bearing. **CAUTION:** Lubricate after washing gun and carriage. Do not use high-pressure washing system for cleaning artillery materiel.

(2) **OILCAN POINTS.** Weekly, lubricate limber base and trail base thrust bearing surface, limber hole support lock, clevises, hinges, latches, etc., with OIL, engine (seasonal grade).

(3) Intervals indicated are for normal service. For extreme conditions of heat, water, sand, mud, snow, rough roads, dust, etc., lubricate more frequently.

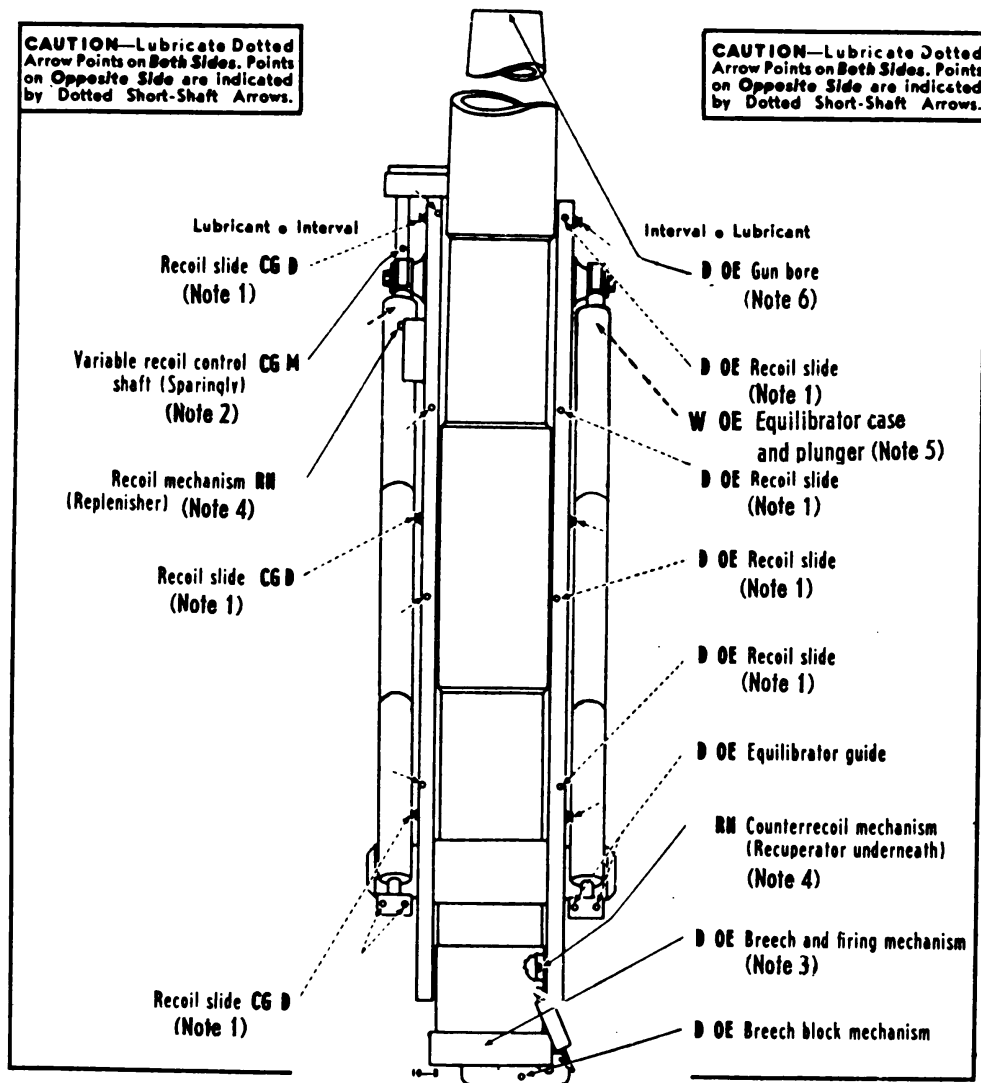
(4) **POINTS REQUIRING NO LUBRICATION SERVICE.** Springs, limber spring pins, bogie torque arms.

b. **Supplies.** In the field it may not be possible to supply a complete assortment of lubricants called for by the lubrication guide to meet the recommendations. It will be necessary to make the best use of those available, subject to inspection by the officer concerned, in consultation with responsible ordnance personnel.

c. **Lubrication Notes.** The following notes apply to the lubrication guides (figs. 337 through 340). All note references in the guides are to the subparagraph below having the corresponding number:

(1) **RECOIL SLIDES.** Daily and before firing, clean and oil exposed metal surfaces. In addition to daily application of CG and OE through

LUBRICATION



KEY

RA PD 80013

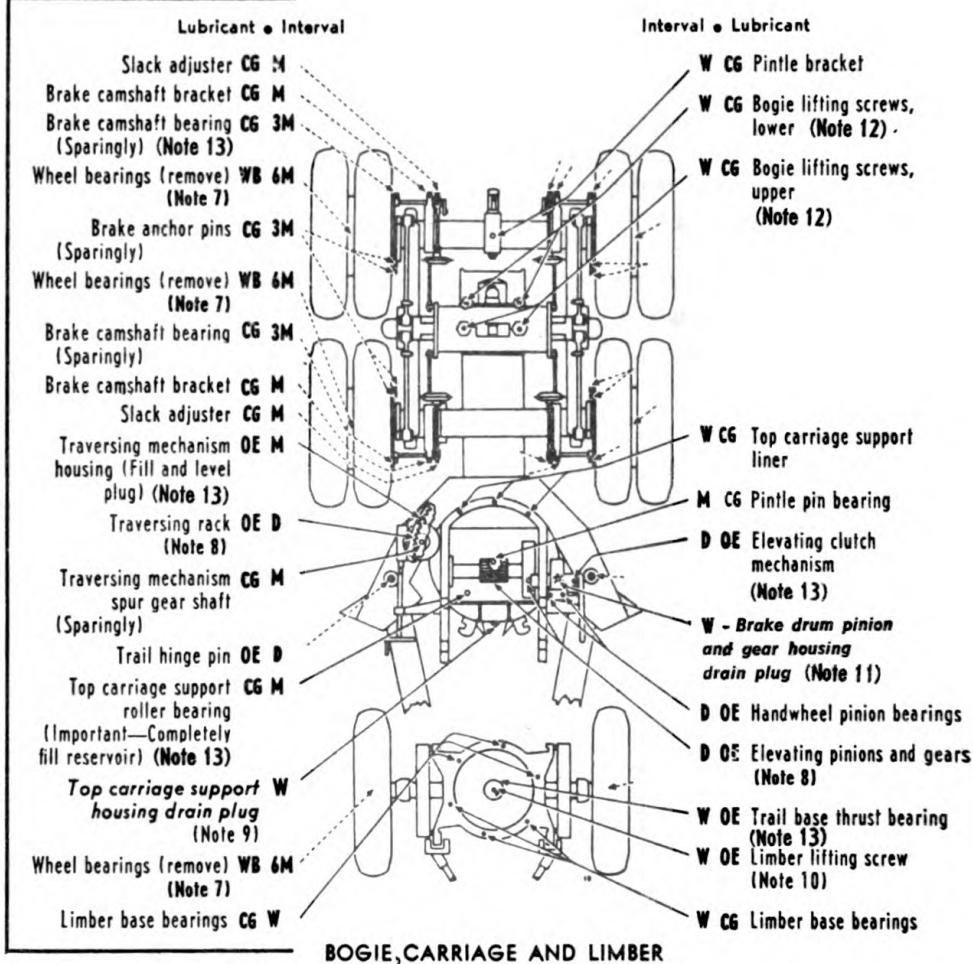
LUBRICANTS	
OE—OIL, engine	CG — GREASE, general purpose
SAE 30 (above +32° F.)	No. 1 (above +32° F.)
SAE 10 (+32° F. to 0° F.)	No. 0 (+32° F. to 0° F.)

INTERVALS
D—DAILY
W—WEEKLY
M—MONTHLY

Figure 337—Lubrication Guide for Gun and Cradle

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

CAUTION—Lubricate Dotted Arrow Points on Both Sides. Points on Opposite Side are indicated by Dotted Short-Shaft Arrows.



KEY

LUBRICANTS	
OE—OIL, engine	CG — GREASE, general purpose
SAE 30 (above +32° F.)	No. 1 (above +32° F.)
SAE 10 (+32° F. to 0° F.)	No. 0 (+32° F. to 0° F.)
	WB—GREASE, general purpose
	No. 2

INTERVALS
D—DAILY
W—WEEKLY
M—MONTHLY
3M—3 MONTHS
6M—6 MONTHS

RA PD 80015

Figure 338—Lubrication Guide for Bogie, Carriage, and Limber—155-mm Gun

LUBRICATION

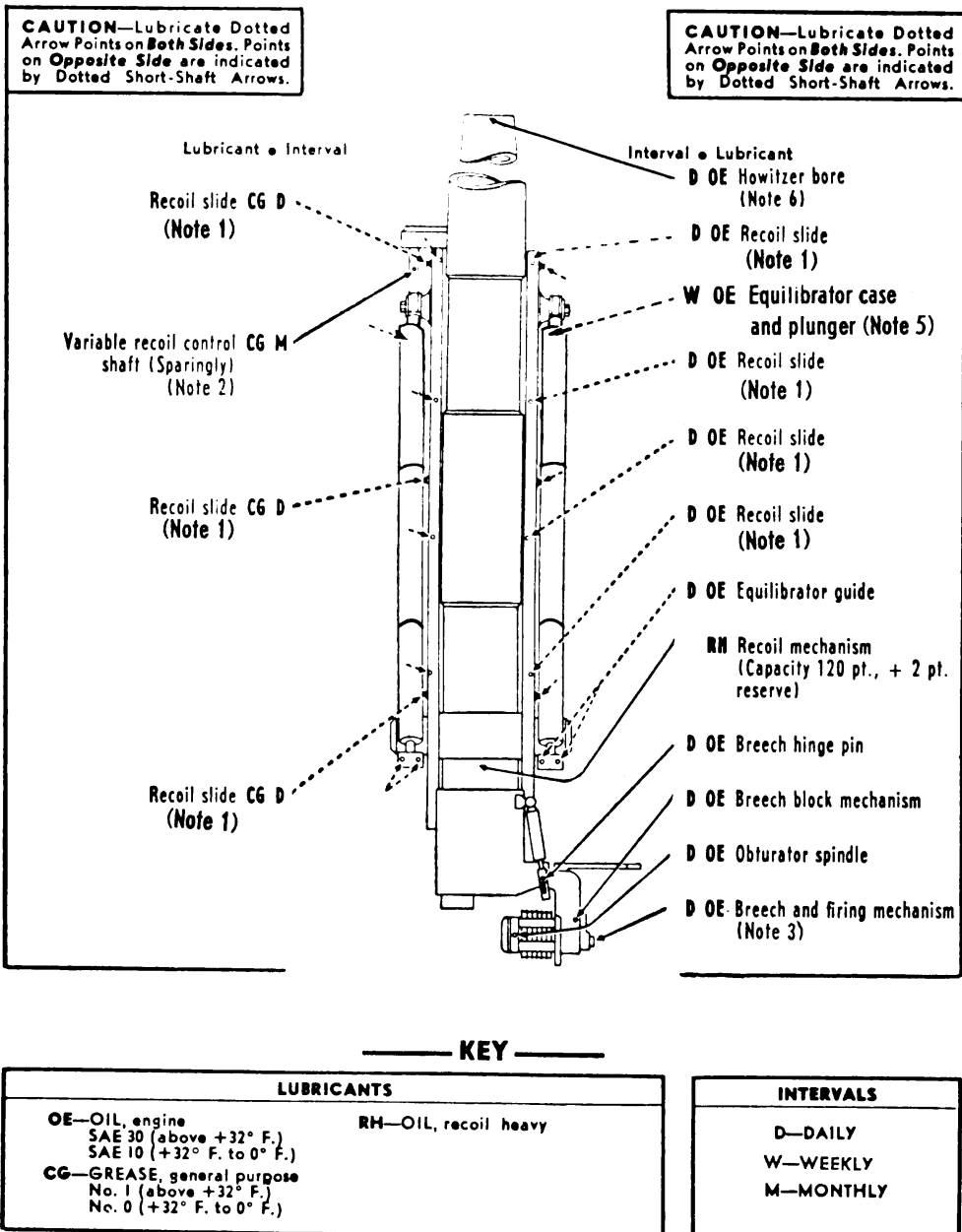
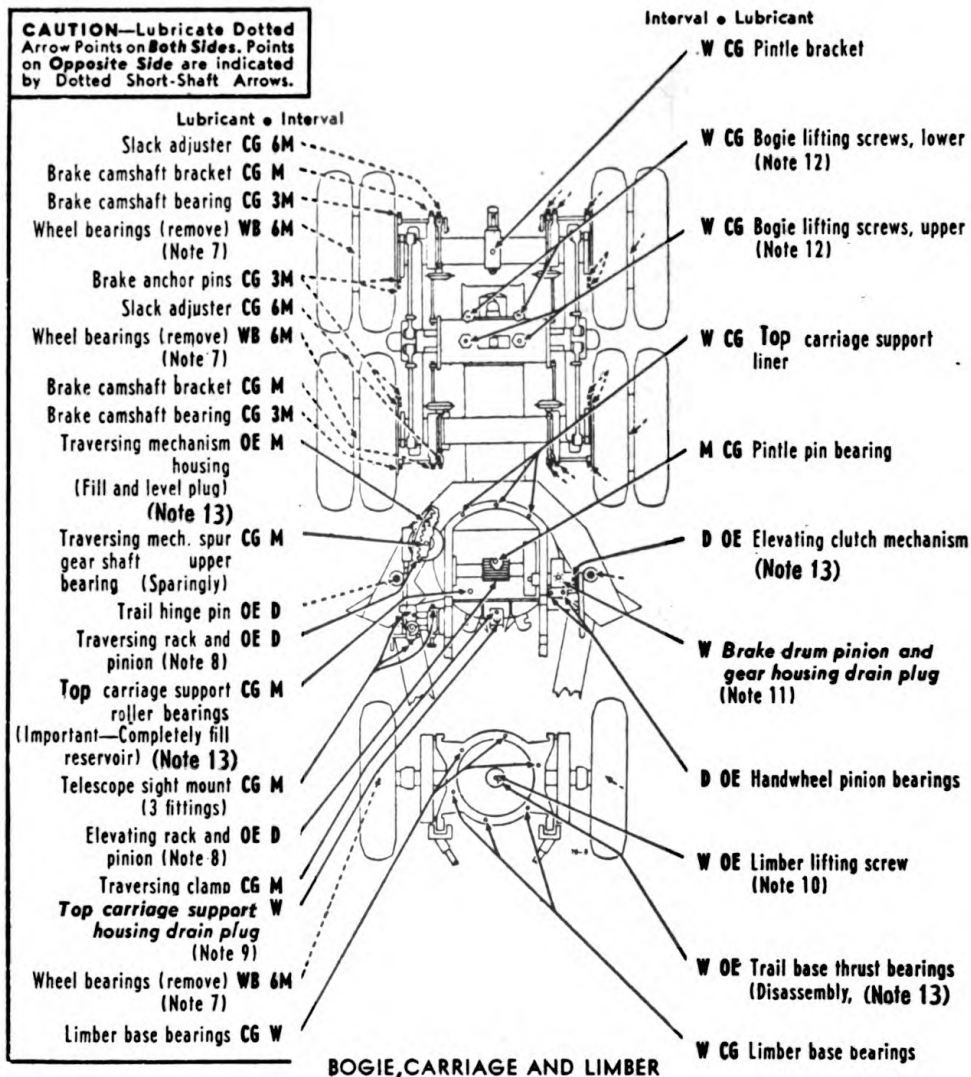


Figure 339—Lubrication Guide for Howitzer and Cradle

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**



RA PD 80016

Figure 340—Lubrication Guide for Bogie, Carriage, and Limber—8-inch Howitzer

LUBRICATION

fittings and oilers, keep exposed surfaces covered with thin film of OIL, engine (seasonal grade).

(2) **VARIABLE RECOIL CONTROL SHAFT.** CAUTION: Bring gun or howitzer to zero elevation and lubricate sparingly.

(3) **BREECH AND FIRING MECHANISM.** Daily and before and after firing, clean and oil all moving parts and exposed metal surfaces with OIL, engine (seasonal grade). CAUTION: To insure easy breech operation and to avoid misfiring in cold weather, clean with SOLVENT, dry-cleaning; dry and lubricate with OIL, lubricating, preservative, light. To clean firing mechanism, remove and operate pin in SOLVENT, dry-cleaning.

(4) **RECOIL FLUID.** For instructions on quantity and application of recoil fluid, refer to War Department Recoil Fluid Guide No. 19 and OFSB 6-6.

(5) **EQUILIBRATOR CASE AND PLUNGER.** With the gun or howitzer at zero elevation, to expose the greatest surface of the inner equilibrator plunger, unscrew the equilibrator cover from the front of the equilibrator and slide it toward the narrow end of the equilibrator case. Wipe accumulated moisture from all exposed metal surfaces. Coat all exposed parts, including outer surfaces of both plunger and case, with a thin film of oil.

(6) **GUN OR HOWITZER BORE.** Daily and after firing, clean and coat with OIL, engine (seasonal grade).

(7) **WHEEL BEARINGS.** To clean and pack wheel bearings properly, remove them from the hub. Follow the procedure below:

(a) Remove bearings from hub, and wash in SOLVENT, dry-cleaning, until all old lubricant is removed from both inside and outside of cage.

(b) Lay bearings aside to dry, and wash inside of hub and spindle with SOLVENT, dry-cleaning.

(c) When bearings are thoroughly dry, pack races with GREASE, general purpose, No. 2, and reassemble in hub. To pack a bearing satisfactorily, it is necessary to knead lubricant by hand into space between the cage and inner race. Coat inside of hub and spindle with a thin coat of grease to prevent rusting. The lubricant packed in bearing races is sufficient to provide lubrication until the next service period. Do not pack hub or hub cap. An excess may result in leakage of lubricant into the brake drum.

(d) Replace wheel and adjust bearings according to instructions in TM 9-335 or TM 9-350.

(8) **ELEVATING AND TRAVERSING RACK AND PINION GEARS.** Daily, clean and apply OIL, engine (seasonal grade).

(a) The teeth of elevating and traversing racks require little lubrication, but as a protection against rust, they must be covered with a thin coat of oil. Dust and grit will adhere to this oily film. Consequently, the teeth must be thoroughly cleaned and fresh oil applied

**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

before elevating or traversing the gun; otherwise, the grit will cause rapid wear of both rack and pinion gear.

(b) If considerable dust is present when gun is operated, the oil should be removed from the gear teeth, and they should remain dry until action is over. If the surfaces are dry, there is less wear than when coated with a lubricant contaminated with grit.

(9) **TOP CARRIAGE SUPPORT HOUSING DRAIN PLUG.** Weekly, remove plug and allow accumulated water to drain.

(10) **LIMBER LIFTING SCREW.** Weekly, loosen locking pin, raise lock, and partially fill chamber with OIL, engine (seasonal grade).

(11) **BRAKE DRUM PINION AND GEAR HOUSING DRAIN PLUG.** Weekly, remove plug, located beneath brake drum housing, and allow accumulated oil to drain.

(12) **BOGIE LIFTING SCREWS.** Keep canvas cover on screws except when operating. Whenever used, clean and apply GREASE, general purpose (seasonal grade), to threads.

(13) **POINTS TO BE SERVICED AND OR LUBRICATED BY ORDNANCE MAINTENANCE PERSONNEL AT TIME OF ORDNANCE INSPECTION.**

(a) *Top Carriage Support Roller Bearings.* To avoid damage from grit that works past the felt seal, the carriage support rollers and their housing must be cleaned with SOLVENT, dry-cleaning, once a year and repacked with GREASE, general purpose (seasonal grade).

(b) *Elevating Clutch Mechanism.* The design of this unit is such that it will not retain oil or grease; therefore, it must be removed every 6 months and the lubricant retaining grooves cleaned and packed with GREASE, graphited, light.

1. Disassemble the clutch operating mechanism by unscrewing the slot-headed bolt in the side of the housing.

2. Remove yoke; clean grooves with SOLVENT, dry-cleaning; dry and repack with fresh lubricant.

(c) *Traversing Mechanism Pinion Gear Shaft Lower Bearing.* This bearing is incased in the lower part of the traversing worm wheel housing. It should be removed and cleaned when the gear is disassembled for service.

(d) *Traversing Mechanism Housing.* Monthly, check level and add OE if necessary. Design of worm wheel housing is such that it cannot be cleaned by flushing.

1. Disassemble once a year or for seasonal change of lubricant, and wash parts in SOLVENT, dry-cleaning.

2. Reassemble and fill case to level plug opening with OIL, engine (seasonal grade).

(e) *Bogie Crossbeam Trunnion Bearings.* Every 6 months, bogie crossbeam trunnion bearings must be cleaned and repacked to prevent dangerous contamination of the lubricant. The following procedure will be used:

LUBRICATION

1. Lower the bottom carriage until it rests on the ground and remove cap on the end of the bearing housing.

2. By means of the lifting screws, raise the bogie chassis enough to allow withdrawal of the bearing.

3. Wash bearings and housing in SOLVENT, dry-cleaning, and dry thoroughly.

4. Pack bearing races with GREASE, general purpose (seasonal grade).

5. Reassemble in housing and replace dust caps.

(f) *Elevating Gear and Pinion Shaft Bearings.* These bearings are not provided with fittings. Every 6 months, they must be removed, washed in SOLVENT, dry-cleaning, and repacked with GREASE, general purpose (seasonal grade).

(g) *Elevating Gear and Pinion Shaft Spur Gear and Pinion.* Every 6 months, disassemble; clean with SOLVENT, dry-cleaning; and coat spur gear and pinion with GREASE, general purpose (seasonal grade).

(h) *Brake Drum Gear and Pinion, Brake Drum Gear Shaft Bearings.* Every 6 months, these gears must be lubricated as follows:

1. Remove cover and wash gears and brake surfaces with SOLVENT, dry-cleaning.

2. Cover gear teeth with a thin coat of GREASE, general purpose (seasonal grade).

3. Clean and pack bearings with GREASE, general purpose (seasonal grade).

4. Make certain no grease reaches the brake surfaces.

5. Do not overlubricate. Surplus grease will be thrown to brake surfaces.

(i) *Cradle Trunnion Bearings.* Trunnion bearings must be cleaned once a year to remove accumulated grit and moisture. They should also be cleaned before changing grades of lubricant. When performing this service, proceed as follows:

1. Remove trunnion covers and clean all grease from bearings, housing, and covers, with SOLVENT, dry-cleaning.

2. Thoroughly dry bearings and housings, and pack bearings with GREASE, general purpose (seasonal grade).

3. Replace trunnion covers and fill housing with the same lubricant.

(j) *Trail Base Thrust Bearings.* Every 6 months, disassemble; clean with SOLVENT, dry-cleaning, and repack with GREASE, general purpose (seasonal grade).

(k) *Traversing Handwheel Shaft Bearing.* Every 6 months, disassemble; clean with SOLVENT, dry-cleaning, and repack with GREASE, general purpose (seasonal grade).

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8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

128. REPORTS AND RECORDS.

a. Reports. If lubrication instructions are closely followed, proper lubricants used, and satisfactory results are not obtained, a report will be made to the ordnance officer responsible for the maintenance of the materiel.

b. Records. Record of seasonal changes of lubricants and recoil oil will be kept in the Artillery Gun Book.

Section XXVI

REFERENCES

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129. STANDARD NOMENCLATURE LISTS.

a. Ammunition.

Ammunition, fixed, including subcaliber ammunition, for harbor defense, heavy field, and railway artillery SNL P-6

Ammunition instruction material for antiaircraft, harbor defense, heavy field, and railway artillery, including complete round data SNL P-8

Charges, propelling, separate loading, 6-in. to 240-mm, inclusive, for harbor defense, heavy field, and railway artillery SNL P-2

Fuzes, primers, blank ammunition, and miscellaneous items for antiaircraft, harbor defense, heavy field, and railway artillery SNL P-7

Projectiles, separate loading, 6-in. to 240-mm, inclusive, for harbor defense, heavy field, and railway artillery, including complete round data SNL P-1

b. Cleaning, preserving and lubricating materials; recoil fluids, special oils, and miscellaneous related items SNL K-1

c. Gun Materiel.

Gun, 155-mm, M1 and M1A1; carriage, gun, 155-mm, M1; Limber, carriage, heavy, M2 SNL D-24

Howitzer, 8-in., M1; carriage, howitzer, 8-in., M1; Limber, carriage, heavy, M2 SNL D-29

Major items of heavy field artillery SNL D-1

d. Sighting and Fire Control Equipment.

Circle, aiming, M1 SNL F-160

Light, aiming post, M14 SNL F-220

Lights, instrument SNL F-205

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8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

Mount, telescope, M18A1 and mount, quadrant, M1	SNL F-180
Posts, aiming	SNL F-35
Quadrant, gunner's, M1 (mils)	SNL F-140
Quadrant, gunner's M1918 (mils)	SNL F-13
Telescope, B.C., M1915 and M1915A1	SNL F-9
Telescope, panoramic, M12	SNL F-214
Telescope, panoramic, M5A5	SNL F-22

Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained as the "Ordnance Publications for Supply Index" OPSI

130. EXPLANATORY PUBLICATIONS.

a. Cleaning, Preserving, and Lubricating.

Cleaning, preserving, lubricating, and welding materials and similar items issued by the Ordnance Department	TM 9-850
Cleaning, preserving and lubricating materials; recoil fluids, special oils, and miscellaneous related items	Table of Allowances
Cold weather lubrication and service of artillery equipment	OFSB 6-5
General instructions for recoil fluid for light and medium artillery (37-mm to 240-mm, inclusive)	OFSB 6-6
Lubrication instructions for gun, 155-mm, M1; carriage, gun, 155-mm, M1 and M1A1	OFSB 6-D-24
Lubrication instructions for carriage, howitzer, 8-in., M1; howitzer, 8-in., M1	OFSB 6-D-29
b. Defense against chemical attack	FM 21-40
c. Heavy wrecking truck M1 (series 1 and 2) ...	TM 9-795
d. Ordnance Maintenance: Star gaging equipment, impression outfits and pressure gages ..	TM 9-1860
e. Service of the Piece.	
Service of the piece, 155-mm gun (coast artillery)	FM 4-25
Service of the piece, 155-mm gun M1 (field artillery)	FM 6-90
Service of the piece, 8-in. howitzer M1	FM 6-91

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8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

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**ORDNANCE MAINTENANCE—155-MM GUNS M1 AND M1A1 AND CARRIAGE M1;
8-INCH HOWITZER M1 AND CARRIAGE M1; HEAVY CARRIAGE LIMBER M2**

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The Adjutant General.

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(For explanation of symbols, see FM 21-6.)

